FINAL REPORT
STUDY OF METHODOLOGIES FOR DETERMINING NONACUTE CARE SERVICE NEEDS FOR PEOPLE WITH AIDS/HIV INFECTION

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EXECUTIVE SUMMARY

'A major mission of the Health Resources and Services Administration (HRSA) is to assist states and local areas to develop comprehensive systems of care for persons with AIDS/HIV infection. Through its ongoing efforts in this area, HRSA has identified the development of AIDS/HIV service planning tools for local communities as a major technical assistance need. In July 1989, HRSA contracted with Mathematica Policy Research, Inc. (MPR) to develop a microcomputer-based service planning modeling system to assist local communities to (1) estimate AIDS/HIV nonacute care service needs, and (2) explore the implications of alternative resources allocation decisions. HRSA's criteria required the modeling system to be needs-based, with costs explicitly excluded. In addition, it was to be readily usable by state and local planners, and sufficiently flexible to accommodate significant variations in the epidemic as well as differences in local service delivery structures and data availability.

METHODOLOGICAL APPROACH

MPR's methodological approach to developing an AIDS/HIV nonacute care services modeling system involved the following steps:

- **Defining the nonacute care service needs of persons with HIV-related diseases and the types and levels of services that can appropriately meet those needs.** To accomplish this we worked extensively with a panel of experts to develop assumptions about the types and levels of care needed by PWAs with different characteristics.

- Structuring the service needs **information in a systematic way. This involved** the development of service substitution matrices, which array groupings of nonacute care services against the patient characteristics that determine the needs for those services.

- **Developing a mathematical projection and optimization framework. The** conceptual structure developed in steps 1 and 2 was integrated into a mathematical modeling framework to produce an AIDS/HIV nonacute care services projection and optimization model. The purpose of the model is to enable policy-makers and planners to (1) estimate the total resources required to serve PWAs in particular ways, and (2) make resource allocation decisions when resources are constrained.

- Creating **a user-friendly software modeling system. The model** developed in step 3 was then incorporated into a user-friendly software modeling system

- Field-testing the modeling system The microcomputer-based modeling system was field-tested in Chicago, New Mexico, and Palm Beach County, Florida, to assess its utility to policy-makers and planners. These three sites were selected because of the range and diversity of the AIDS/HIV service planning issues and problems that they face.

ESSENTIAL CONCEPTS IN MODELING AIDS/HIV NONACUTE CARE SERVICE SUBSTITUTION

The fundamental principle underlying the AIDS/HIV nonacute care services modeling system is that nonacute care services can be appropriately substituted for each other to meet the needs of symptomatic HIV-infected people. The analytical tool developed to demonstrate service substitutability is the service substitution matrix, which is comprised of three components: service populations, patient characteristic groups, and service configurations.

- Service populations. Subgroups of the PWA population having unique nonacute care service needs, which require separate service needs estimates and projections to be made, are defined as distinct service populations. HIV transmission categories-frequently used to classify PWAs--are not appropriate groupings for nonacute care service needs planning, since the transmission categories do not necessarily correspond to service needs. The three service populations suggested by the expert panel are (1) chemically-dependent adults, (2) HIV-infected families with children, and (3) other HIV-infected adults. Alternative service population classifications suggested by field test participants include source of payment and geographic location.

- Patient characteristic groups. Within each service population, PWAs are classified into patient characteristic groups having relatively homogeneous service needs. These groups are generally defined by combinations of key characteristics such as level of impairment, availability of a caregiver, homelessness, the need for infusion therapy, and the need and desire for hospice care. Two high-level service need groups, with extensive nursing care needs, are also included. Field test participants generally agreed with the patient characteristic group structure, although questions arose about the necessity for including infusion therapy needs among the key patient characteristics.

- Service configurations. These are bundles of services that can provide a day of appropriate care to PWAs in one or more patient characteristic groups. Only services that the panel considered to be essential, that are not primarily provided on an informal basis, are included in the model. In addition, ambulatory care services are excluded, except where ambulatory care is an appropriate substitute for in-home care. The appropriate service configurations are defined by the services included in the service bundle and the amount of each service that is needed The appropriate services to be included in the service bundle are a function of the residential settings in which services are provided: institutions,

residential facilities, housing, or private homes Because of the wide variation that exists in local standards of care, field test participants had some disagreements with the types and amounts of services included in the service configurations, although more disagreements arose over service amounts than the services themselves. This highlights the importance of allowing model users to have the flexibility to tailor the service configurations to meet their needs.

- **Service substitution matrices. The service substitution** matrix for each service population arrays the patient characteristic groups against the corresponding service configurations, and indicates the range of appropriate service configurations for each group. The matrices were considered to be important policy-making tools by field test participants, providing them with a conceptual structure for reviewing AIDS/HIV service planning issues and policy issues.

A major concern in utilizing service substitution matrices for AIDS/HIV service planning is the availability of data for estimating the prevalence of service population/patient characteristic groups and also for estimating the availability of services. Case management data, although somewhat biased, can facilitate prevalence estimation, provided that communities have the necessary database management capabilities. This information can be supplemented by data from other sources, including outpatient clinic data and hospital discharge data. The complexity of obtaining service availability data varies by the size of community; obtaining meaningful service availability information in complex metropolitan health care markets is difficult

The expert panel's conclusion that HIV-infected families with children are a unique service population with very complex service needs was confirmed in all three of the site visits. Unfortunately, the panel and MPR were unable to reach consensus on the appropriate service delivery structure for HIV-infected families and children, and service substitution matrices have not been developed for this population. However, this is clearly a priority population on which future model development activities should be focused.

AIDS/HIV NONACUTE CARE RESOURCE ALLOCATION AND PROJECTION

MPR has integrated the service substitution matrices into a mathematical modeling framework to create a nonacute care services projection and optimization model This model has been automated to produce a user-friendly software modeling system for planning AIDS/HIV nonacute care services. The following modeling approaches are included in the software modeling system:

- **Nonacute care resource allocation.** In this modeling approach, mathematical optimization techniques are used to allocate constrained nonacute care resources in accordance with the planner's objectives. Two specific resource allocation options are included in the software modeling system: (1) maximization of the number of people served; and (2) serving based upon a user-specified priority ranking of patient characteristic group priorities.

- **Nonacute care** resource **projection.** This modeling approach allows the user to estimate the resources needed to serve all **PWAs** in **user-designated** service **configurations.** These may correspond to "ideal" placements or to some alternative set of service configurations. No service substitution occurs when this approach is **used.**

THE MICROCOMPUTER MODEL FOR **PLANNING AIDS/HIV NONACUTE** CARE SERVICES

The software modeling system developed by **MPR** mirrors the requirements of the conceptual model. Separate modules allow the user to:

- **Modify the lists** of services and **service configurations.**
- Enter (1) service population/patient characteristic group prevalence estimates and (2) service availability estimates.
- **Define** service configurations and designate appropriate service configurations.
- Specify "ideal" service configurations and assign priorities to service population/patient characteristic groups.
- **Specify** the planning goals to be **used.**
- Review the model results.
- Save model settings to retrieve previous or default settings.

Users can modify the parameters and assumptions in the modeling system, but they cannot alter the structure of the system or modify the algorithms by which the service needs estimates are generated.

A set of performance requirements and selection constraints was used to evaluate potential software packages to be used in developing the software modeling system. Based upon these criteria, Clipper was selected as the software package to be used for the user interface. For the **optimization** algorithm, MPR **obtained** and modified Stanford University's **MINOS** system.

USING THE MODEL AS A POLICY TOOL

A hypothetical case study has been developed which illustrates the utility of the model as a policy tool

When services are tightly constrained, only a fraction of the PWA population is served but not all services are used. **This** seemingly contradict&y result occurs when some home- and community-based services are so tightly constrained that maintaining people in the home is not possible, even though other home- and community-based services are **plentiful.**

Using the option to maximize the number of people served results in the least severely impaired people being placed in home- and community-based service configurations first. Serving based upon patient characteristic groups priorities, with priority being given to the most severely impaired PWAs, leads to a significant shift in the groups that are served and greatly reduces the overall number of people served. This is because, with constrained resources, many fewer severely impaired people can be served in the home than mildly or moderately impaired people.

FUTURE DIRECTIONS FOR AIDS/HIV NONACUTE CARE SERVICES MODELING

HRSA's original conception of the use of a matrix to display AIDS/HIV nonacute care service substitutions has proved to be a powerful mechanism for stimulating debate about appropriate standards of care in the community. Based upon the site visit experiences, the service substitution matrices can serve as catalysts for the establishment of a policy development and planning process. The incorporation of the service substitution matrices into a microcomputer-based projection and optimization model adds another dimension to the planning process, by enabling planners to explore the consequences of different policy decisions.

During the field tests, several suggestions were made concerning future directions for this type of modeling work_ These suggestions fell into three areas:

1. Revisions to the conceptual structure of the model. Users wanted greater flexibility to adapt the matrices and the model to their specific community needs. In particular, they wished to increase the number of service populations and modify the patient characteristic groups. Although, technically, this could be done, considerable effort should be directed towards ensuring that users understand the changes in the conceptual structure of the model that may result.

2 Expansion of the optimization options. Two further options of particular interest would allow users to (1) set priorities on within-group service configurations, and (2) specify more complex priority structures. Both of these options would require major programming efforts, as well as extensive documentation and more training than the existing options.

3. Incorporation of service costs. As originally conceived by HRSA, the model was to be a needs-based planning model, in which service costs would not be a factor. However, field test participants emphasized that the model's utility to policy-makers would be greatly enhanced if the cost consequences of different resource allocation decisions could be analyzed. Three possible ways of incorporating costs into the modeling structure are (1) cost multipliers, (2) budget models, and (3) cost minimization models. Cost multipliers would involve the addition of a simple multiplicative component to the current model, and would be the simplest and least costly of the three options to develop. Under a budget model, the availability of particular services would be determined by the planner's overall budget and the cost of individual services. The cost minimization approach would significantly alter the philosophy and intent of the model. Planner's priorities would now be specified in terms of

minimizing the costs of service provision, given an appropriate standard of care. Budget and cost minimization models would both require a major model development effort.

CONCLUSIONS

The AIDS/HIV nonacute care services modeling system represents a first attempt develop a microcomputer-based service planning tool based upon the dual concepts of ser substitution and optimization. This approach has potentially great value in assisting state local AIDS/HIV service planners to make critical resource allocation decisions. The sen substitution matrix, in particular, provides a conceptual structure for thinking about resou allocation decisions that policy-makers and planners find extremely helpful. The extent to wh the model will be used, however, will depend upon whether (1) communities can obtain necessary data to utilize the model, and (2) additional m&cations can be made to enhance model's utility to policy-makers.

L INTRODUCTION

A major mission of the Health Resources and Services Administration (HRSA) is to assist states and local areas to develop **comprehensive systems of care for persons with** HIV-related disorders, Through its ongoing efforts in this area, HRSA has identified the development of AIDS/HIV service planning tools for local communities as a major technical assistance need. In July 1989, HRSA contracted with Mathematica Policy Research, Inc. (MPR) to develop a microcomputer-based service planning modeling **system to assist local communities to (1)** estimate AIDS/HIV nonacute care service needs, and (2) explore the implications of alternative resource allocation decisions. Nonacute care services are defined to include the spectrum of institutional, residential, and home- and community-based services needed by persons with AIDS and HIV-related disorders (PWAs) who are not acutely ill.[1]

HRSA's criteria required the conceptual model to be needs-based with costs explicitly excluded. In addition, the modeling system was to be readily usable by state and local planners, and sufficiently flexible to accommodate significant variations in the epidemic as well as differences in local service delivery structures and data availability.

This report presents the results of this project

A. RATIONALE FOR THE PROJECT

The HIV epidemic poses major challenges to the U.S. health care system in the 1990s. By the end of July 1990, over 143,000 AIDS cases had been reported to the Centers for Disease Control (Centers for Disease Control, 1990c), and the projected number of cases through 1993 range from 390,000 to 480,000 (Centers for Disease Control, 1990b). Some metropolitan health

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'For simplicity, **throughout this report all symptomatic persons with HIV-related disorders are** referred to as PWAs.

care delivery systems are already threatened by the sheer volume of AIDS and HIV-related morbidity cases they are handling. Furthermore, the epidemic is no longer confined to the urban epicenters of the disease. Seventeen percent of the AIDS cases reported in the year ending July 1990 were from outside major metropolitan areas, and the most rapid increases in AIDS cases are now occurring in communities with populations of less than 500,000 (Centers for Disease Control, 1990a and 1990c). The characteristics of the affected populations are also changing. In the adult population, AIDS incidence is increasing most rapidly among IV drug users and heterosexuals, with concomitant increases in the number of perinatal cases. Reflecting these changes in transmission categories, the largest relative increases in adult AIDS incidence are occurring among the black and Hispanic populations and among women (CDC, 1990a).

The growth and changing composition of the HIV-affected population have been accompanied by new developments in medical treatment and patient management, that are increasing longevity and changing the nature of HIV-related diseases. HIV-related morbidity is now recognized as a treatable chronic illness characterized by a long asymptomatic period. Once they become symptomatic, HIV-infected people have similar health care needs to other chronically ill people; although they experience sudden acute episodes of illness, most of their service needs are nonacute. Furthermore, due to rapid changes in medical technology and standards of care, many of the medical treatments required by symptomatic HIV-infected people (PWAs), once only provided in inpatient hospital settings, can now be provided in outpatient settings and the home.

Planning to meet the service needs of the rapidly growing PWA population has become a major concern of state and local governments. Many PWAs are homeless, lack access to home- and community-based services, and have no source of reimbursement for nonacute care. Consequently, the burden of HIV-related care is growing dramatically in public hospitals. These problems will become more severe unless alternative nonacute care services can be developed

that are both affordable and accessible, and that provide the appropriate level of care. Given the limited resources available to serve PWAs, the development of such alternatives will require careful planning and resource allocation decisions. Unfortunately, however, nonacute care service planning for PWAs has proved to be extremely difficult, due to data inadequacies and other methodological problems. It is these problems that the AIDS/HIV nonacute care modeling project seeks to address. The intent of the project is to develop methodologies to assist states and local communities to plan to meet the needs of HIV-infected people in the 1990s. To this end, MPR has developed an AIDS/HIV nonacute care services modeling system, which takes into account the extent to which nonacute care services are appropriate substitutes for each other.

B. OBJECTIVES OF THE REPORT

This report has the following major objectives:

- To describe the conceptual structure of the model and its underlying assumptions
- To explain the mathematical modeling framework used to estimate resource requirements and to make resource allocation decisions
- To explain the relationship between the conceptual model and the resulting microcomputer-based software modeling system, and to discuss the key software development issues
- To demonstrate how the modeling system can be used in AIDS/HIV nonacutc care service planning at the local level
- To explore future directions for AIDS/HIV nonacutc care service needs modeling

In discussing these issues, we emphasize that the microcomputer-based software modeling system is primarily a means for automating the underlying conceptual model of service needs estimation and resource allocation. The report focuses considerable attention on the underlying conceptual

structure and assumptions of the model, since an understanding of the model structure is essential for interpreting the resource allocation results.

C. METHODOLOGICAL APPROACH TO MODEL DEVELOPMENT

Our methodological approach to developing an AIDS/HIV nonacute care services modeling system involved several distinct but inter-related steps. First, we sought to define the nonacute care service needs of persons with HIV-related diseases and the types and levels of services that can appropriately meet those needs. To accomplish this, MPR staff worked extensively with a panel of experts on the nonacute care service needs of persons with AIDS/HIV infection to develop assumptions about the types and levels of care needed by PWAs with different characteristics. In the second step of the project, this service needs information was structured in a systematic way, so that service substitution possibilities could be explored analytically. The analytical tools developed, known as service substitution matrices, array nonacute care service needs against the patient characteristics that determine those needs. The third step in our approach involved integrating the service substitution matrices into a mathematical modeling framework to produce an AIDS/HIV nonacute care services projection and resource allocation model. This model allows planners to estimate the resource requirements associated with different patterns of care and to make resource allocation decisions when nonacute care services are constrained. In the fourth step, this model was incorporated into a user-friendly software modeling system to facilitate use of the model for service planning. Finally, when the software modeling system was developed, we field tested it in three locations to explore its utility to local AIDS/HIV policy-makers and service planners, and to identify potential problems and future modifications.

D. COMPOSITION AND ROLE OF THE EXPERT PANEL

The expert panel in this project played a central role in determining the nonacute service needs of PWAs and the factors that affect those needs. The time frame for the panel's work was short-only two months-and the bulk of the work was performed in two two-day meetings. Recognizing the time constraints under which the panel would have to work, HRSA stipulated that the panel should have only five members, since a large panel would have been unwieldy and less likely to reach consensus. The small panel size necessitated very careful selection of the individual panel members, in order to ensure that a broad range of viewpoints and experiences was represented. The following five nationally recognized experts were selected by HRSA and agreed to serve on the panel:

1. **Gary Burke, M.D.,** Medical Director of the New York State AIDS Institute in Albany, New York and New York City
2. **Jane Crigler,** Principal of Jane Crigler and Associates, planning consultant for AIDS/HIV services in Seattle
3. **Michael Merdian, Executive** Director, National Association of People With AIDS (NAPWA) in Washington, D.C., and former Executive Director of the Coalition of People With AIDS in Dallas
4. **Wayne Nagel, RX, M.S.N.,** Program Director of Harbor Home Support Services, a home health agency for persons with HIV-related diseases in Chicago
5. Mark Smith, M.D., Director of AIDS Services at the Johns Hopkins University Medical Center in Baltimore and past Chair of the Philadelphia AIDS Commission

We were remarkably fortunate to have had the opportunity to work with this unique group of experts, who undertook their assigned task with enthusiasm and dedication. The expert panel's work and the development of the service substitution matrices are described in detail in a previous report (Bilheimer, Phillips, and Asher, 1990), which is included as Appendix B.

E. ROLE AND SIGNIFICANCE OF THE FIELD TESTS

The field tests of the AIDS/HIV nonacute care services modeling system, which were conducted in June, July, and August 1990, had three major purposes: (1) to gain insights into the appropriateness of the conceptual structure that we had developed to characterize AIDS/HIV nonacute care service substitution; (2) to explore the utility of the model to AIDS/HIV service planners at the community level; and (3) to identify the data problems communities would face in utilizing this type of modeling approach_ The field test sites were the City of Chicago, the State of New Mexico, and Palm Beach County, Florida. These three sites were selected because of the range and diversity of the AIDS/HIV service planning issues and problems that they face.

- City of Chicago. We selected Chicago because it is a Iarge metropolitan area, with a cumulative AIDS incidence of over 3,500 cases, giving the city the seventh highest cumulative incidence among metropolitan areas with populations of 500,000 or more. Three-quarters of the reported cases in Chicago involve gay/bisexual contact and, although the most rapid increases in transmission are occurring among IV drug users, gay/bisexual contact is expected to remain the primary mode of transmission for the foreseeable future. The epidemic is growing most rapidly in the black and Hispanic populations, which nw account for one-half of all reported AIDS cases. The inner-city minority populations live a considerable distance from the major health care providers. Service inaccessibility compounds minority PWAs' problems in obtaining appropriate health care. The city has received a HRSA Demonstration Grant, which was awarded to the Chicago AIDS Foundation. This is being used to develop case management services in low-income inner-city areas. In addition, the Chicago Department of Health coordinated an extensive AIDS strategic planning initiative in 1989, which has provided the city with a blue-print for AIDS health services development.

- State of New Mexico. In complete contrast to Chicago, New Mexico is a rural state with a cumulative AIDS incidence of less than 300 cases through July 1990. The prevalence of HIV-related disorders is thought to be considerably higher than this incidence figure suggests, because of a considerable in-migration of PWAs from other parts of the country. To date, the mode of HIV transmission in New Mexico has been almost entirely gay/bisexual contact. The State was one of the first to receive a Medicaid home- and wmmunity-based service waiver for AIDS patients. Under the waiver, a comprehensive community-based system of care is being developed for PWAs, including those living in isolated

rural areas. Case management services for PWAs are available in every county of the State. The State received a HRSA planning grant in 1989.

- Palm Beach County, Florida We were keenly interested in including a Florida site among the field tests, in order to gain insights into AIDS/HIV service planning models for women and children. Palm Beach County, with a cumulative total of more than 1,200 AIDS cases, actually has a higher AIDS incidence rate than Chicago. The epidemic is concentrated in two regions of the county, with different characteristics. Belle Glade, in western Palm Beach County is a very poor community, with a high concentration of migrant workers, and a very high HIV infection rate. The PWA population in Belle Glade is almost entirely black, and 88 percent of the cases are associated with IV drug use, heterosexual contact, or beiig born in a Pattern II country. Almost one-third of the adult cases are female, and over 5 percent of all cases are pediatric In contrast, almost half the reported AIDS cases in the coastal region of Palm Beach County are in the white, non-hispanic population., and almost half the cases are associated with gay/bisexual contact. However, the coastal region also has a relatively high rate of reported heterosexual contact cases (18 percent of adult cases) and female cases (17 percent of all adult cases). Service delivery issues are very different in the two regions; distances from providers are much greater in the coastal region than they are in Belle Glade, but the poverty and poor housing conditions in Belle Glade greatly complicate appropriate health care delivery for PWAs. The Comprehensive AIDS Program of Palm Beach County (CAP) has received a Robert Wood Johnson Case Management Grant and a HRSA Demonstration Grant These have been used to develop a centralized case management system and to develop home- and community-based services for PWAs.

Participants in the field tests included representatives of state and local governments involved in AIDS/HIV service planning, AIDS/HIV service providers, and AIDS/HIV community-based organizations. All these participants were extremely generous with their time, and the project benefited immeasurably from their constructive reviews, comments and insights

Because of their significance and importance for all aspects of the modeling process, the field tests findings are discussed in the appropriate chapters of this report rather than summarized in a separate chapter.

F. OUTLINE OF THE REPORT

The remainder of the report is structured as follows. In Chapter II, the essential concepts for modeling AIDS/HIV nonacute care service substitution are descrii The chapter focuses on four key constructs: service populations, patient characteristic groups, service configurations, and service substitution matrices. Chapter XII describes the mathematical modeling approaches that we have used for allocating and projecting AIDS/HIV nonacute care resources. This is followed, in Chapter IV, by an overview of the microcomputer software modeling system, which incorporates the conceptual model into a user-friendly software system. The use of the model as a policy-making tool is illustrated in a simple case study in Chapter V. Finally, Chapter VI discusses future directions for AIDS/HIV nonacute care service needs modeling.

The report also includes four appendices. Appendix A is the Review of Data and Literature. Appendix B is the report on AIDS/HIV Service Substitution Matrices. Appendix C is the Users' Guide to the Modeling System. Appendix D is the Field Test Protocol,

II. ESSENTIAL, CONCEPTS FOR MODELING AIDS/HIV NONACUTE CARE SERVICE SUBSTITUTION

The fundamental principle underlying the AIDS/HIV nonacute care modeling system is that nonacute care services can be appropriately substituted for each other in order to meet the needs of symptomatic HIV-infected people. Given variations in both the service needs of the HIV-infected population and in resource availability at the community level, different service delivery structures for PWAs are appropriate, if not necessarily ideal. The analytical tool that we have developed to demonstrate service substitutability is the service substitution matrix, which arrays nonacute care service needs against patient characteristics. Service substitution matrices, which are the essential constructs for the entire modeling process, are discussed in considerable detail in this chapter. First, however, we review the three basic components of the matrices: service populations, patient characteristic groups, and service configurations. (For a more extensive discussion of the development of the service substitution matrices, see Appendix B.)

A. SERVICE POPULATIONS

An important question to be addressed in planning services for PWAs is whether distinct service populations exist for whom separate service need estimates and projections should be made. The use of distinct service populations for service planning may be necessary if subgroups of the PWA population have unique service needs or have characteristics that affect service availability. The expert panel members supported the concept of planning for distinct service populations and suggested that we should develop a planning model to address the needs of three distinct service populations: HIV-infected families with children, HIV-infected adults with chemical dependence problems[3], and other HIV-infected adults. These service populations differ

[3]In previous reports in this project, the term "substance abusers" was used to denote chemically-dependent adults. We have changed the terminology used, because of concerns raised at one of the field test sites that "substance abusers" was a pejorative term.

from the HIV-transmission categories used in AIDS surveillance reporting, which form the basis for most AIDS prevalence estimates and projections.

In this section, the following issues are discussed: (1) the use of service populations versus HIV transmission categories for planning nonacute care services for PWAs; (2) HIV-infected families with children as a distinct service population; (3) alternative service population structures; and (4) data issues in estimating service populations.

1. Service Populations Versus HIV-Transmission Categories

As currently used in the model, service populations are subgroups of the PWA population having unique service needs or for whom service availability is limited because of their clinical characteristics. Separate service needs estimates and projections must be made for each distinct service population. The usual approach to classifying PWAs into distinct subgroups is to use HIV transmission categories, such as the following:

- Gay/bisexual
- Gay/bisexual IV drug user
- Heterosexual IV drug user
- Sex partner of risk group member
- Child of risk group member
- Blood product related

Unfortunately, HIV transmission categories are not appropriate groupings for nonacute care service planning since the mode of HIV transmission is not necessarily a good indicator of current service needs, Three factors contribute to the weakness of a service planning model based upon HIV transmission categories:

1. A major determinant of nonacute care service needs is chemical dependence of all types, of which IV drug use is but one category. By focusing on IV drug transmission, we effectively ignore all other types of chemical dependence, such as cocaine, crack, or alcohol addiction, which can have just as profound implications for both service needs and service availability as IV drug use. Furthermore, individuals who became HIV-infected through IV drug use are not necessarily current IV drug users, and it is current chemical dependence that is of concern in estimating nonacute care service needs.

2 The nonacute care service needs of HIV-infected gay and bisexual men are, in general, no different from those of other HIV-infected adults. Thus, singling out gay and bisexual men as a separate service population does not facilitate nonacute care service planning.

3. The use of a transmission category structure for planning services does not enable one to identify the population of HIV-infected families with children. The perinatal transmission category focuses upon HIV-infected infants and ignores the larger family structures of which they are a part.

The expert panel and MPR took these limitations of the transmission category approach into account in determining the appropriate service populations to be used in AIDS/HIV nonacute care service needs planning. Based upon their own experiences as service providers and planners, panel members believed that HIV-infected chemicallydependent adults, HIV-infected families with children, and other HIV-infected adults were the three key service populations, for whom separate service substitution matrices should be developed. Adults who are chemically dependent were considered to be a service population distinct from other HIV-infected adults, both on account of their more extensive service needs and because of more limited service availability.' HIV-infected families with children were considered to be a distinct service population because of the complexity and interdependence of the medical and social service

'Note that the term "chemical dependence", as used in the model, does not include occasional alcohol and drug use. In planning services for PWAs we are concerned with levels of drug and alcohol use that have a significant impact upon the patient's plan of care.

needs of HIV-infected mothers and children The inclusion of a fourth distinct group, composed of the severely mentally ill, was also much debated by the panel. However, since in most states the number of HIV-infected people in this category would be relatively small, the decision was made not to include this group as a separate service population.

2 HIV-Infected Families With Children as a Distinct Service Population

The panel's conclusion that HIV-infected families with children are a distinct service population with very complex service needs was confirmed in all three of the site visits that we conducted In our discussions of this topic, service providers, case managers, and service planners emphasized the importance of addressing the medical and social support needs of the global family unit, rather than any one individual in the family. The site visits also affirmed the panel's view that the family unit of concern was an HIV-infected mother and her children, although there was less agreement on whether this service population should include HIV-infected mothers whose children are not infected.[5]

We learned from both the panel and the site visits that planning to meet the service needs of HIV-infected mothers and children is extraordinarily difficult, because of the multiplicity of problems which these families typically face in addition to HIV infection, such as poverty, homelessness, and/or drug involvement in the household. The expert panel and MPR were unable to reach consensus on the appropriate service delivery structure for HIV-infected mothers and children, and service substitution matrices have not been developed for this population. However, based upon our site visit experiences, we believe that assessing the feasibility of developing service planning models for HIV-infested mothers and children should be a major priority for future AIDS/HIV Service planning and modeling activities.

[5]In Palm Beach County, HIV-infected mothers whose children are not infected and those who are not living with their children are included in the adult case management population.

3. Alternative Service Population Structures

AIDS/HIV service populations define distinct groups of HIV-infected people for whom nonacute care services should be separately planned. When WC developed this concept in conjunction with the expert panel, we were primarily concerned with identifying populations of HIV-infected people with unique service needs; hence, the attention paid to chemical dependence and families with children. The second criterion for identifying service populations was service availability, which, again, caused us to distinguish chemically dependent adults from other adults, because the availability of some services for chemicallydependent PWAs was believed to be more limited than for other PWAs. More limited service availability for chemicallydependent adults results from provider unwillingness or inability to serve adults with drug or alcohol addictions.

When we field-tested the modeling system, many issues were raised about the service populations included in the model. As a result of the field tests, two important questions concerning the service populations must be addressed:

1. Is the service population structure used in the model valid and useful for AIDS/HIV nonacute care service planning?

2 What are the policy implications of planning for service populations that are defined by criteria other than clinical need?

These issues are discussed in this section.

a Validity and Utility of Service Populations

Participants in all three field test sites supported the concepts of planning for distinct service populations. They did not all agree, however, with the service population structure developed by the expert panel and MPR. HIV-infected mothers with children were universally accepted as a distinct service population, but some doubts were voiced about planning for chemically-dependent adults as a distinct service population.

Although some of the service needs of chemicallydependent PWAs differed from those of other adults, the key patient characteristics affecting nonacute care service needs were not viewed as substantively different for the two groups.[6] (The patient characteristics that affect service needs are discussed later in this report.) Furthermore, in none of the three sites was chemical dependence considered to be a major factor affecting service availability-with the important exceptions of residential facility and housing services. Thus, if the service delivery system is essentially the same for chemicallydependent and other adult PWAs, and if most of the key patient characteristics that determine service needs are the same, then chemical dependence may be an additional important patient characteristic that affects needs but may not define a distinct service population.

Clearly, the issue of whether chemicahydependent adults constitute a distinct service population needs to be explored further. At present, however, we believe that utilizing this service population structure has considerable utility. Planning for chemically-dependent adults as a distinct service population requires service planners to review the service needs of chemically-dependent adults and the availability of services to meet those needs. Through this explicit policy process, policy-makers can determine whether chemically-dependent adults are, indeed, a distinct service population in their community.

b. Implications of Other Criteria for Defining Service Populations

The AIDS/HIV nonacute care services modeling system is based upon HRSA's underlying philosophy of health service planning: clinical needs of PWAs should be identified and services developed to meet those needs. However, when we field-tested the modeling system, we found that the primary criterion used by AIDS/HIV service planners for identifying service populations was service accessibility-both geographic and financial-rather than service needs. Thus, in New

[6] The major differences in service needs related to the greater amounts of case management needed by chemically dependent adults, in addition to their alcohol and drug treatment needs.

Mexico, two possible service population structures were proposed: (1) urban residents versus rural residents, because of the service access problems that exist in rural areas; and (2) participants in the Medicaid AIDS waiver versus nonparticipants, because a much broader range of services can be provided to *waiver* participants. The importance of source of payment for identifying unique service populations was also emphasized in Chicago, with distinctions being made between Medicaid, privately insured, and uninsured clients. Chicago staff stated that not only is source of payment a critical determinant of how services are planned but, in addition, it may be a proxy for many other important characteristics affecting service needs and service availability. In Palm Beach County, the most important factor distinguishing between service populations was geographic location: Belle Glade versus the coastal region. Again, this distinction served as a proxy for several important population characteristics, in addition to service availability and accessibility.

Defining service populations by service accessibility raises important philosophical questions about the use of the model for service planning. At issue is whether such an approach is compatible with a planning philosophy that is based upon defining clinical needs and developing systems of care to meet those needs. Service planning models that lead to the development of different systems of care for people facing different accessibility barriers may reinforce the existing inequalities in the health care delivery system.

Planners who define service populations by geographic location should first consider whether they are planning for entirely separate communities rather than distinct service populations. This appeared to be the situation in Palm Beach County, for example, where Belle Glade and the coastal region were viewed as two separate communities for planning purposes. Although some providers worked in both regions, the two regions had essentially separate service delivery systems. This separation of communities was not nearly so clear cut in New Mexico and Chicago. In New Mexico, urban and rural residents were being served by the same networks of

providers, but accessibility problems were far greater in rural regions. Similarly, in Chicago, accessibility problems were much more severe in the South and West Sides than in other parts of the city; although some community providers existed to serve these populations exclusively, important services for PWAs were only available from providers in other parts of the city. Thus, we would not view New Mexico's rural areas and Chicago's South and West Sides as separate planning communities. Should the differences in service accessibility, therefore, be used as a basis to define distinct service populations?

No simple response can be given to this question because the policy implications depend upon how such a service population structure is used. If service populations defined by differences in geographic accessibility are used to institutionalize accessibility differences, then, clearly, the clinical need philosophy of the model is violated Alternatively, if clinical service needs are defined for each service population using the same standards and criteria, so that the magnitude of the service accessibility gaps can be demonstrated, then the service population structure may be entirely compatible with the underlying philosophy of the model.

Similar issues arise in defining service populations by source of payment. Planning for services on the basis of source of payment runs counter to the clinical philosophy of the model if this approach is used to institutionalize existing inequities in the health care delivery system. However, a service population structure that is based upon source of payment could be used to demonstrate the relative differences in service accessibility for PWAs with different sources of payment, if the same criteria are used to define service needs regardless of payment source. For example, demonstrating the different service placements that would result if uninsured PWAs with different levels of need were served in the most appropriate or 'ideal" way, versus the way in which they would actually be served because of their Lack of resources, could have major policy implications.

We believe that the issues surrounding the underlying philosophy of service planning for PWAs, and of how the modeling system might be used at the community level, must be explored further with AIDS/HIV service planners across the country. In particular, we need 8 clearer understanding of p&y-makers' intents when they define service populations by source of payment. Such an approach could serve either to reinforce or to highlight existing service access inequalities. At present, we do not know which approach is likely to predominate.

4. Data Issues in Estimating Service Populations

In order to plan services to meet the needs of PWAs in different service populations, estimates and projections of the numbers of persons living with HIV-related diseases in each service population are needed. A major advantage of an AIDS/HIV service planning model that is based upon HIV transmission categories is the availability of AIDS surveillance data disaggregated by transmission category, which facilitate the development of prevalence projections. (However, a limitation of the surveillance data is that they only include surveillance definition AIDS cases, and assumptions have to be made about the prevalence of other HIV-related morbidity.) A disadvantage of the use of service populations instead of transmission categories for modeling AIDS/HIV nonacute care service needs is that prevalence estimation becomes more difficult, although the extent of the data problems is a function of the particular service population structure being used. For example, states and communities may have more information available about the distribution of PWAs by reimbursement source or geographic location, than about the prevalence of chemical dependence among PWAs or the proportion of HIV-infected women living in families with children.'

'Note that all existing sources of information about population characteristics can only provide retrospective or current information. This can be problematic when planning services to meet the needs of HIV-infected people in the future, because of the rapidity with which the HTV epidemic is evolving and the service populations are changing.

Centralized case management data can provide important insights into the prevalence of different AIDS/HIV service populations, but a biased picture may be presented because the availability, accessibility, and acceptability of case management services vary by service population_ On the one hand, persons with severe chemical dependence problems may not participate in case management systems because they have very little contact of any type with the health care system. *Conversely,* privately insured PWAs may choose not to participate in a centralized case management system because they do not feel that they have a need for the service. Indeed, in some instances, privately insured PWAs may not be eligible to participate in case management systems. In New Mexico, for example, the centralized case management system only includes PWAs who are participating in the Medicaid waiver, little is known about PWAs who are not receiving waiver services, although the database does include an initial assessment of all persons applying for the waiver, regardless of whether they are ultimately found to be eligible. In contrast to New Mexico, staff in both Palm Beach County and Chicago stated that they did not believe that the client populations included in their case management systems were unrepresentative of their overall PWA populations. In Palm Beach County, the case management population used to include a disproportionately large number of low-income PWAs, but this has changed considerably over time as higher-income PWAs have come to accept the importance of case management In contrast, the case management clientele in Chicago included a relatively small proportion of low-income, minority PWAs in the past. However, the HRSA demonstration grant has been used to place case managers in low-income areas of the city, which has increased the proportion of low-income PWAs in the case management system In general, we inferred from our conversations with case managers at the site visits that the biases that exist in any particular AIDS/HIV case management database vary from community to community, depending upon the focus of case management services in the community.

Data limitations notwithstanding, all the AIDS/HIV service providers and planners from around the country, with whom we have discussed the issue, reiterate the importance of shifting to a service population approach for planning AIDS/HIV nonacute care services, and express their frustration with planning based upon transmission categories. In order to break this new ground, states and communities should be encouraged and assisted to explore multiple sources of data on the HIV-infected population, of which the AIDS surveillance data are just one component. Other important sources of information, in addition to case management data, include:

- Seroprcvalence data from newborn blood testing
- Hospital discharge and outpatient clinic data
- Medicaid data
- Data from alcohol and drug treatment clinics

Apart from newborn seroprevalence data, which are obtained on all newborns, these databases will all reflect different biases because of the particular populations that they represent. However, by using these multiple sources of data in conjunction with the surveillance data, assumptions can be made about the proportions of the PWA population that fall into the different service populations. Inevitably, these estimates will be rough, but they can serve policy-makers needs, provided that they are used appropriately. Planners should estimate likely ranges for these proportions and test the sensitivity of the service needs estimates to variations in the proportions.

B. PATIENT CHARACTERISTIC GROUPS

Classification of the PWAs in each service population into patient characteristic groups having relatively homogeneous service needs is an important feature of the conceptual structure of the model. Experience in planning long term care services for the elderly and for chronically ill people has shown that certain patient characteristics, such as the level of functional impairment

and the availability of a caregiver, critically affect service needs and the viability of different service options. These same characteristics are also important in planning to address the nonacute care service needs of PWAs, as are other characteristics that are more specifically related to HIV infection. In this section we review (1) key patient characteristics and combinations of characteristics that affect nonacute care service needs, (2) the appropriateness of the patient characteristic groups included in the model, (3) patient characteristic groups for HIV-infected mothers and children, and (4) data issues in estimating the prevalence of patient characteristic groups.

1. Key Patient Characteristics and Combinations of Characteristics that Affect Nonacute Care Service Needs

The expert panel discussed the key patient characteristics that should be included in the model at length, recognizing both the need for parsimony and also the need to include the range of characteristics that could adequately describe groups of patient with similar nonacute care service needs. As a result, the following five characteristics are used in the model to describe the large majority of PWAs for whom services are planned:

1. **Level of** Functional **Impairment.** Four levels of impairment are included in the model. Severely impaired PWAs are those requiring assistance in toileting, transferring, or eating, and those who are a danger to themselves or others due to cognitive deficits or severe mental illness. Moderately impaired PWAs are those requiring assistance in bathing or dressing and those who are unable to direct their own care due to cognitive deficits. Mildly impaired PWAs are those needing assistance to perform one or more of the tasks included in measures of the instrumental activities of daily living, such as shopping, meal preparation, housekeeping, or using public transportation. Unimpaired PWAs are those requiring no assistance with either the activities of daily living or the instrumental activities of daily living.

2 Private Home **Available/Not Available. Homelessness** is a critical factor affecting the service needs of PWAs and the feasibility of alternative systems of care. A very broad definition of homelessness or lacking a private home has been used in the model. Specifically, PWAs lacking a

private home or receiving any form of subsidy or public support for shelter are considered to be homeless.

3. **Live-In Caregiver** Available/Not Available. For impaired PWAs, the viability of home- and community-based service options may depend upon the availability of an informal caregiver who is willing and able to care for the client. Live-in caregivers who work outside the home, or who have other responsibilities (e.g. child care), which require a substantial portion of their time, are considered to be available on a part-time basis.

4. **Needs Infusion Therapy/Does Not Need Infusion** Therapy. Many PWAs need "high tech' infusion therapy services for the administration of medical treatments and parenteral nutrition. The expert panel recommended that this characteristic be specifically included in the model because infusion therapy needs can have a significant impact upon appropriate placements.

5. Needs and Desires Hospice Care. Some PWAs seek palliative care at the end of life rather than aggressive treatment. PWAs who need and desire hospice care are not expected to live more than a few weeks or months.

Severity of illness was not specifically included as a patient characteristic in the model because, for most chronically ill patients, once the level of impairment has been taken into account, the severity of illness does not provide additional discriminatory information for determining nonacute careneeds.

The nonacute care service needs of PWAs are determined by the interactive effects of multiple patient characteristics. For example, a moderately impaired individual with a home and a full-time caregiver available has very different service needs than a similarly impaired individual who is homeless and has no caregiver. For modeling purposes, therefore, we wished to identify the key combinations of patient characteristics that determine nonacute care service needs. Working in conjunction with the expert panel, we developed a list of patient characteristic groups from combinations of the five key characteristics listed above, such that all PWAs within a particular group would have relatively homogeneous nonacute care service needs

The patient characteristic groups included in the model are shown in Table II.1. In general, patients are first classified into two groups according to whether they have a private home available. These groups are then subdivided by levels of impairment, the availability of an informal caregiver, and the need for infusion therapy. In addition to these groups, two "high level" patient characteristic groups are also included in the model: (1) PWAs needing aggressive skilled care to recover from an acute illness episode; and (2) PWAs needing skilled care constantly available or very frequently. Patients in these two categories are assumed to have such high levels of service need that the availability of a home and/or an informal caregiver is irrelevant, since panel members assumed that PWAs in these classifications would need to be placed in skilled care institutions.

2 Appropriateness of the Patient Characteristic Groups in the Model

When we field-tested the model we found considerable agreement with the patient characteristic group structure developed by the expert panel, although some disagreements arose concerning infusion therapy and the high-level service need groups. Staff at all three sites agreed that the level of impairment, the availability of a caregiver, and homelessness were critically important characteristics that would be taken into account in developing a plan of care. The issue of infusion therapy needs was more controversial, because of the rapid changes in local standards of care for high-tech nursing procedures. When the expert panel met a year ago, infusion therapy was generally performed either in institutions or by skilled nurses in the home or in outpatient settings. Now, self-administration of infusions has become much more widespread, although administration by patients and/or caregivers does not obviate the need for skilled care for monitoring purposes Furthermore, the ability to self-administer infusions is partially dependent upon other patient characteristics. For example, a moderately-impaired patient could not self-administer without assistance, and so the presence or absence of a capable

TABLE IL1

PATIENT CHARACTERISTIC GROUPS INCLUDED IN THE MODEL

I. CHEMICALLY-DEPENDENT ADULTS

1. Needs aggressive skilled care
2. Needs skilled care frequently

Homeless

3. Needs and desires hospice; full-time live-in caregiver
4. Needs and desires hospice; no full-time live-in caregiver

5. Severely impaired; full-time live-in caregiver; infusions
6. Severely impaired; full-time live-in caregiver; no infusions
7. Severely impaired; no full-time live-in caregiver; infusions
8. Severely impair@ no full-time live-in caregiver; no infusions

9. Moderately impaired; full-time live-in caregiver; infusions
10. Moderately impaired; full-time live-in caregiver; no infusions
11. Moderately impaired; part-time live-in caregiver; infusions
12. Moderately impaired; part-time live-in caregiver; no infusions
13. Moderately impaired; no live-in caregiver; infusions
14. Moderately impaired; no live-in caregiver; no infusions

15. Mildly impaired; full-time/part-time live-in caregiver; infusions
16. Mildly impaired; full-time/part-time live-in caregiver; no infusions
17. Mildly impaired; no live-in caregiver; infusions
18. Mildly impaired; no live-in caregiver; no infusions

19. No impairment; infusions
20. No impairment; no infusions

Home Available

21. Needs and desires hospice; full-time live-in caregiver
22. Needs and desires hospice; no full-time live-in caregiver

23. Severely impaired; full-time live-in caregiver; infusions
24. Severely impaired; full-time live-in caregiver; no infusions
25. Severely impaired; no full-time live-in caregiver; infusions
26. Severely impaired; no full-time live-in caregiver; no infusions

27. Moderately impaired; full-time live-in caregiver; infusions
28. Moderately impair@ full-time live-in caregiver; no infusions
29. Moderately impair@ part-time live-in caregiver; infusions
30. Moderately impaired; part-time live-in caregiver; no infusions
31. Moderately impaired; no live-in caregiver; infusions
32. Moderately impaired; no live-in caregiver; no infusions

33. Mildly impaired; full-time/part-time live-in caregiver; infusions
34. Mildly impaired; full-time/part-time live-in caregiver; no infusions
35. Mildly impaired; no live-in caregiver; infusions
36. Mildly impaired; no live-in caregiver; no infusions

37. No impairment; infusions
38. No impairment; no infusions

II. OTHER ADULTS

These patient characteristic groups are repeated for the other adult population

caregiver is an important determinant of the amount of professional assistance needed. In spite of the shift in treatment standards, a significant number of PWAs cannot be taught to self-administer infusions, particularly chemicallydependent adults and severely socioeconomically disadvantaged populations. In Belle Glade, for example, PWAs are hospitalized if they need infusions.

These site visit findings leave the importance of infusion therapy need as a key patient characteristic unclear. Because of the wide variation in methods of acceptable medical practice for delivering infusion therapy, there may be marked differences in the way this service is provided in different communities. Furthermore, the development of oral substitutes for infusions will diminish infusion therapy's importance in the future. For the present, however, because of the need for regular patient monitoring by a skilled provider even when self-administration is widely practiced, we believe that the need for infusion therapy should remain as one of the patient characteristics included in the model.

Differences of opinion also arose in the site visits over the two high-level patient characteristic groups: (1) PWAs needing aggressive skilled care; and (2) PWAs needing skilled care constantly available or very frequently. As mentioned earlier, the expert panel assumed that the availability of a private home and the availability of a caregiver were not relevant issues when planning care for PWAs in these two categories, since it was assumed that PWAs needing these levels of skilled care would be placed in institutions. In New Mexico, however, we found that PWAs with these high-level needs were being cared for in the home, since the Medicaid waiver allowed the provision of round-the-clock skilled care. To accommodate patterns of care such as these, future versions of the model might incorporate the high-level groups into the general patient characteristic groups structure, treating them, in effect, as higher levels of impairment

3. Patient Characteristic Groups for HIV-Infected Mothers and Children

Although the model does not currently include the mothers with children service population, we took the opportunity at the site visits to explore the patient characteristics that affect the service needs of this population. Among the three field test sites, the staff at the Comprehensive AIDS Program of Palm Peach County (CAP) had the most experience in working with HIV-infected mothers and children. According to CAP staff, the following key characteristics are taken into account in developing a plan of care for HIV-infected mothers and their children:

- The presence or absence of an extended family
- Homelessness
- The mother's level of knowledge and understanding of how to care for herself and her child or children
- The mother's disease stage

Site visit participants in Chicago also emphasized the importance of extended families in caring for HIV-infected mothers and children; in Chicago, grandmothers are often the primary caregivers for their HIV-infected grandchildren.

4. Data Issues in Estimating the Prevalence of Patient Characteristic Groups

In order to use patient characteristic groups as a basis for planning services, data are needed on the prevalence of the key patient characteristic groups within each service population. As with service population data, the primary sources of information on the prevalence of patient characteristics and combinations of characteristics are centralized case management systems, supplemented by information from other sources such as hospital discharge data and outpatient clinic data When using case management databases to estimate the prevalence of the patient characteristic groups, three questions must be addressed:

1. Are the important individual characteristics, such as homelessness, caregiver availability, infusion therapy needs, and impairment levels included in the case management assessment instrument?

2 Can information on the prevalence of the key combinations of patient characteristics be generated from the database?

3. How biased is the case management information?

Automated case management databases were in various stages of development in all three of the field test sites, and we determined that the case management assessment instruments beiig used in those sites included most of the key patient characteristics included in the model. New Mexico, for example, has data on impairment levels, homelessness, infusion therapy needs, hospice care needs, aggressive skilled care needs, and frequent skilled care needs. Although no information currently exists on caregiver availability in New Mexico, questions on this topic could be added to the assessment instrument without difficulty.

Developing estimates of the key combinations of patient characteristics was more problematic, because of limited database management capabilities in all three sites. Some reports were beiig generated from the case management database systems in New Mexico and Palm Beach County, which are farther ahead in developing their case management databases than Chicago. However, these reports were prepared specifically to meet the reporting requirements for the HRSA Demonstration Project and a Robert Wood Johnson case management grant, and more general querying of the databases was not possible Nonetheless, although their database management systems cannot currently generate the patient characteristic group information, all three sites are planning to develop more sophisticated report capabilities as part of their case management database systems These enhanced capabilities should enable them to generate the patient characteristic group information for the model. These Endings are encouraging, since the field test sites were not specifically selected for their database management capabilities.

The issue of the bias in case management data has already been discussed in the context of the service population data. An additional factor, to be taken into account when estimating the prevalence of patient characteristics, is whether the case management data are biased towards PWAs at certain impairment levels. The field test findings indicate that this is the case. In New Mexico, for example, mildly impaired and unimpaired PWAs are not included in the case management system, since they are not eligible for the Medicaid waiver.' We inferred that the case management data in Chicago may also underrepresent PWAs with little or no impairment At the other end of the impairment spectrum, institutionalized PWAs may not be included in the case management system, since they have few case management needs.

As with the other biases discussed, the magnitude of these impairment-level biases, and their implications for nonacute care service planning appear to vary from community to community, depending upon the target population of the case management system Service planners and policy-makers should understand the inherent biases in their own case management systems and seek supplementary information from other sources whenever possible.

C SERVICE CONFIGURATIONS

PWAs in different service Population/patient characteristic groups rquire a variety of different services to meet their needs. To understand how these service needs are estimated in the model, two distinct but related concepts are introduced. The ultimate purpose of service planning is to determine the amount of each individual service-such as skilled nursing home care, skilled home health nursing, attendant care, or infusion therapy-that is needed, However, in order to meet the needs of a PWA in a particular service population/patient characteristic group, the different service configurations that can meet those needs appropriately must be identified.

'Some mildly impaired and unimpaired PWAs may have initial assessments performed in order to determine their eligibility, and these data will be included in the system.

A service configuration consists of the bundle of services that is necessary to provide a day of care. In institutional settings the individual service and the service configuration are usually identical. A skilled nursing facility, for example, usually provides a comprehensive package of services for its residents. In contrast, maintaining chronically ill people in the community requires combinations of services provided by a range of different providers and volunteer organizations, in addition to the care that is provided by informal caregivers.

A considerable part of our work with the expert panel involved defining the appropriate service configurations to meet the needs of PWAs in different service population/patient characteristic groups. The issues we addressed and our site visit findings are discussed in this section, in which the following topics are reviewed: (1) critical services included in the model; (2) definition of service configurations; (3) appropriateness of the services and service need assumptions included in the model; and (4) data issues in estimating service availability.

1. Critical Services Included in the Model

The first step in developing the service configurations was to identify the key individual services to be included in the model. Because of PWAs' extensive service needs, the inclusion of a large number of nonacute care services could be justified from a programmatic perspective. However, modeling requirements limit the number of services that can be included as do the practical realities of developing service availability estimates for all services included in the model. Faced with the need for parsimony, MPR and the expert panel developed a list of services to be included in the model, based upon the following criteria:

- The service was perceived as essential.
- The service was not primarily provided on an informal basis.
- Ambulatory care services were excluded, except where ambulatory care was considered to be an appropriate substitute for in-home care.

The resulting list of services, shown in Table II.2, has two components: (1) residential services for homeless PWAs or PWAs who can no longer stay in their own homes; and (2) other support services needed by PWAs, that are either included as part of the service package provided by institutions or residential facilities, or provided by community-based providers in the place of residence or in outpatient settings. As can be seen, the range of services that need to be provided by community-based providers in the place of residence or in outpatient settings depend upon the PWA's residential situation.

2 Definition of Service Configurations

All PWAs in a particular patient characteristic group are assumed to have homogeneous service needs that are determined by the combination of characteristics that define the group. Depending upon the patient characteristic group, several appropriate service configurations may exist. Defining these appropriate configurations requires planners to determine (1) which services should be included in the service bundle, and (2) the amount of each of these services that is needed.

The appropriate services to be included in the service bundle are a function of the residential setting in which services are provided Four types of residential settings are included in the model: institutions, residential facilities, housing, and private homes. The primary distinction between these settings lies in the amount of care that is provided as part of that residential option, as opposed to being provided by other organizations. The service configurations that are included in the model are classified according to the four type5 of residential settings, and additional services are added as needed to provide a day of care. At one extreme, in the institutional configurations, no additional services are required_ At the other extreme, in housing and private home configurations, all required services must be provided by

TABLE II.2

SERVICES INCLUDED IN THE MODEL

Residential Services	
Institutions	Provide comprehensive package of services. Include extensive skilled nursing facilities, extensive attendant care facilities, institutional hospices, rehabilitative skilled care facilities, and hospitals.
Residential facilities	Provide partial package of services. Include congregate living facilities providing case management, attendant care, transportation, or meal services.
Housing services	Provide no additional services other than housing. Include subsidized apartments, single room occupancy hotels, rent subsidies for private homes, and congregate living facilities with no support services.
Other Services	
Standard Skilled Nursing	Includes skilled nursing services for medical monitoring, administration of medical treatments, supervision of attendants, and direction of care. May be provided (1) as part of an institutional service package, (2) in residential facilities, private homes, or housing by community-based providers, or (3) in outpatient settings.
Hospice Nursing	Includes palliative nursing care for terminally ill patients. May be provided (1) as part of an institutional hospice package, or (2) in private homes or housing by community-based providers.
Infusion Therapy	Includes "high-tech" nursing services for intravenous drug administration or parental nutrition. May be provided (1) as part of an institutional service package, (2) in residential facilities, private homes, or housing by community-based providers, or (3) in outpatient settings.
Attendant Care	Includes assistance with routine medical care, personal care, and homemaker services. May be provided (1) as part of an institutional or residential facility service package, or (2) in private homes or housing by community-based providers.

TABLE II.2 (continued)

SERVICES INCLUDED IN THE MODEL

Case Management	Includes care coordination and client advocacy services. May be provided (1) as part of an institutional service package for PWAs in extensive skilled care facilities, extensive attendant care facilities, and institutional hospices, or (2) by community-based providers for PWAs when temporarily in hospitals, and rehabilitative skilled care facilities, plus those living in residential facilities, private homes or housing.
Transportation	Includes medical transportation services. May be provided (1) as part of an institutional or residential facility service package, or (2) by community-based providers for PWAs living in residential facilities, private homes, or housing.
Adult Day Care	Includes attendant care, plus nutrition, socialization, counseling, and skilled nursing services provided in a community setting.
Drug Treatment Services	Includes ti-eatment for all forms of chemical dependence, including alcohol, IV drugs, and other drugs. In the model., this service is assumed to be provided in an outpatient setting.

community-based and/or outpatient providers. Table II.3 summarizes the relationship between residential settings and the additional servicer needed in the service configurations. For any particular patient characteristic group, one or more residential settings may be appropriate, The amounts of additional services required in non-institutional residential settings are a function of the level of need of the patient characteristic group. Although sign&ant variations in the standard of care are likely at the community level, the expert panel and MPR developed a set of default values for the amounts of services needed in each service configuration. These provide a baseline to which communities can compare their own standards of care. For most services, such as standard nursing and case management, variations in needed amounts between patient characteristic groups are generally assumed to be small. However, large variations are assumed to occur in the amounts of attendant care needed by PWAs in different patient characteristic groups as a result of variations in impairment levels and informal caregiver availability. Consequently, four levels of attendant care are included in the service configurations:

1. Extensive Attendant Care. This is defined as paid attendant care available on a round-the-clock basis, 7 days a week The pane1 assumed that this level of attendant care would only be provided in institutions.

2 Substantial Attendant Care. This is defined as paid attendant care provided for 8 hours a day, 5 days a week

3. Moderate Attendant Care. This is defined as paid attendant care provided for 2 hours a day, 7 days a week

4. Minimal Attendant Care. This is defined as paid attendant care provided for 2 hours a day, 3 days a week.

In addition to variations in service amounts, non-institutional service configurations also differ in the way services are provided Thus, for example, two service configurations may include identical amounts of all services, but in one configuration some services may be provided in the home, and in the other configuration the same services may be provided in an outpatient setting.

TABLE IL3

SERVICE CONFIGURATION SUMMARY

Residential Setting	Services Provided by Residence	Additional Services Rewired
Institutions	**All Needed Services**	None
Residential Facilities	Attendant Care Case Management Transportation	Infusion Therapy Standard Nursing Drug Treatment
Housing	None	**All** Needed **Services**
Private Home	None	**All** Needed **Services**

These differences in service location lead to differences in medical transportation needs; transportation needs are greater in a service configuration in which several of the services are provided in an outpatient setting than in a configuration in which these services are provided in the home.

The complete list of service configurations included in the model is shown in Table II.4. The service configuration numbers included in the table are the numbers used in the planning model to denote the particular service configurations. Details of the actual amounts of each service included in each configuration can be found in Appendices B and C.

3. Appropriateness of the Service Configurations Included in the Model

Given the wide variation that exists in local standards of care for PWAs, we fully expected the field test participants to disagree over the appropriateness of the services and the service configurations included in the model Disagreements certainly arose in all three site visits, but all participants appeared to agree with the fundamental concept of defining service configurations by the type of residential setting. In general, there was more disagreement over the amounts of services included in the configurations than over the services themselves_ The following issues, in particular, caused extensive discussions:

- **The provision of rehabilitative and extensive skilled nursing care in the home. The expert** panel and MPR assumed that rehabilitative and extensive skilled nursing care would only be provided in institutional settings. Consequently, none of the residential facility, private home, or housing configurations include this level of skilled nursing care. However, as previously discussed, round-theclock skilled nursing care in the home is being provided in New Mexico under the Medicaid waiver. This level of skilled nursing care in the home would be considered inappropriate in Palm Beach County and Chicago.

- **The amounts of attendant care included in the service configurations.** The level of attendant care was considered to be too high in the substantial attendant care service configurations. For PWAs with substantial attendant care needs, 4-6 hours of attendant care per day appeared to be the norm, rather than 8 hours per day. In contrast,

TABLE L

SERVICE CONFIGURATIONS INCLUDED IN THE MODEL

Residential Setting	Service Configuration Number	Service Configuration Description
		L CHEMICALLY-DEPENDENT ADULTS
Institutions	IN1	Hospital
	IN2	Rehabilitative skilled care
	IN3	Extensive skilled care
	IN4	Hospice nursing
	INS	Extensive attendant care
Residential Facilities	RS1	Moderate attendant care facility; home standard nursing; home infusions; drug treatment.
	RS2	Moderate attendant care facility; home standard nursing; outpatient infusions; drug treatment
	RS3:	Moderate attendant care facility; home standard nursing; no infusions; drug treatment.
	RS7:	Moderate attendant care facility; outpatient standard nursing; home infusions; drug treatment.
	RS8:	Moderate attendant care facility; outpatient standard nursing; outpatient infusions; drug treatment.
	RS9:	Moderate attendant care facility; outpatient standard nursing; no infusions; drug treatment.
	RS4:	Minimal attendant care facility; home standard nursing; home infusions; drug treatment
	RS5:	Minimal attendant care facility; home standard nursing; outpatient infusions; drug treatment.
	RS6:	Minimal attendant care facility; home standard nursing; no infusions; drug treatment,
	RS10:	Minimal attendant care facility; outpatient standard nursing; home infusions; drug treatment.
	RS11:	Minimal attendant care facility; outpatient standard nursing; outpatient infusions; drug treatment.
	RS12:	Minimal attendant care facility; outpatient standard nursing; no infusions; drug treatment,

TA. II.4 (CONTINUED)

SERVICE CONFIGURATIONS INCLUDED IN THE MODEL

Residential Setting	Service Configuration Number	Service Configuration Description
Housing	HO1:	Home hospice; transportation; case management; drug treatment
	HO2:	Substantial attendant care; transportation; case management; home standard nursing; home infusions; drug treatment.
	H03:	Substantial attendant care; transportation; case management; home standard nursing; no infusions; drug treatment.
	HO4:	Moderate attendant care; transportation; case management; home standard nursing; home infusions; drug treatment
	HO5:	Moderate attendant care; transportation; case management; home standard nursing; outpatient infusions; drug treatment.
	HO6:	Moderate attendant care; transportation; case management; home standard nursing; no infusions; drug treatment.
	HO19:	Moderate attendant care; transportation; case management; outpatient standard nursing; home infusions; drug treatment.
	HO20:	Moderate attendant care; transportation; case management; outpatient standard nursing; outpatient infusions; drug treatment.
	H021:	Moderate attendant care; transportation; case management; outpatient standard nursing; no infusions; drug treatment.
	HO7:	Minimal attendant care; transportation; case management; home standard nursing; home infusions; drug treatment.
	HO8:	Minimal attendant care; transportation; case management; home standard nursing; outpatient infusions; drug treatment.
	HO9:	Minimal attendant care, transportation; case management; home standard nursing; no infusions; drug treatment.
	H22:	Minimal attendant care; transportation; case management; outpatient standard nursing; home infusions; drug treatment.
	H23:	Minimal attendant care; transportation; case management; outpatient standard nursing; outpatient infusions; drug treatment.
	H24:	Minimal attendant care; transportation; case management; outpatient standard nursing; no infusions; drug treatment.

TABLE II.A (CONTINUED)

SERVICE CONFIGURATIONS INCLUDED IN THE MODEL

Residential Setting	Service Configuration Number	Service Configuration Description
Housing (continued)	H10:	Adult day care; transportation; case management; borne infusions; drug treatment.
	H11:	Adult day care; transportation; case management; outpatient infusions; drug treatment.
	H12:	Adult day care; transportation; case management; no infusions; drug treatment.
	H13:	Transportation; case management; home standard nursing home infusions; drug treatment.
	H14:	Transportation; case management; home standard nursing; outpatient infusions; drug treatment.
	H25:	Transportation; case management; outpatient standard nursing; home infusions; drug treatment.
	H26:	Transportation; case management; outpatient standard nursing; outpatient infusions; drug treatment.
	H15:	Transportation; case management; home infusions; drug treatment.
	H16:	Transportation; case management; outpatient infusions; drug treatment.
	H17:	Transportation; case management; home standard nursing; drug treatment
	H27:	Transportation; case management; outpatient standard nursing; drug treatment
	H18:	Case management; drug treatment
Private Home		The private home service configurations are identical to the housing configurations, and use the same numbering system, prefaced by P instead of H.

II. OTHER ADULTS

The service configurations for other adults are the same as those for chemically-dependent adults, minus drug treatment. (Note, also, that chemically-dependent adults are assumed to have more intensive ease management needs.).

however, extensive (i.e. round-the-clock) attendant care, which the panel assumed would only be provided in institutions, is being provided in the home under the New Mexico Medicaid waiver. The provision of extensive attendant care in the home would, again, be considered inappropriate in Palm Beach County and Chicago.

- The **amounts of case management included in the service configurations. The expert** panel and MPR assumed that **chemically-**dependent **PWAs** desiring case management **services** would require 3 hours of case management a month, and all other adults **PWAs** desiring case management services would require 1.5 hours a month_ These estimates were thought to be too low in all three sites, but actual case management amounts varied widely. In New Mexico, up to 10 hours of case management per client per month can be provided under the waiver. In Palm Beach County, case managers have a caseload of 80 clients each, which translates into **approximately** 2 hours per client per month. Case managers in Palm Beach County considered these caseloads to be excessive and **inappropriate.**[8] In Chicago, case managers have caseloads of 40 clients each, which translates into approximately 4 hours per client per month. These caseloads were also thought to **be** excessive.

- **The inclusion of adult day care as an appropriate service for PWAs. The expert** panel and **MPR** considered adult day care to be an appropriate service option for moderately impaired **PWAs** living at home with part-time **caregivers.** Adult day care was not available for **PWAs** in any of **the** field test sites. Some site visit participants stated that the service would probably never be developed in their communities because it was considered to be inappropriate and demeaning to **PWAs.**

- **The exclusion of ambulatory medical care from the model.** Site visit participants stated that as more prophylactic drugs and other new treatments are developed for HIV-infection, ambulatory medical care may become the most constrained service for HIV-infected people. **Some** participants considered ambulatory medical care as the most important service for which they had to plan and thought that it should be added to the **model.**

Our site visit discussions of appropriate service configurations to meet the needs of **PWAs** with **different** characteristics clearly demonstrated the importance of developing a planning model which allows users to modify the baseline service amounts included in the **configurations.** What is considered appropriate care in one community may be considered inappropriate in another, and

[8]**These** caseloads were for social case management only. Additional nursing management was provided for **PWAs** with intensive needs.

these local standards of care appear to be critically affected by the services that are actually available in the community and their financial accessibility. For example, in Palm Beach County, where publicly-funded skilled nursing home care for PWAs is available, long-term provision of attendant care in the home was considered to be inappropriate, and there was less philosophical opposition to institutional care for PWAs than elsewhere,

In addition to the issues of service amounts, the definition of attendant care raised questions in Palm Beach County and Chicago. In the model, attendant care is defined to include both personal care and homemaker services. We did not distinguish between the two components, because models of care for PWAs have developed in which an attendant provides both types of services. This has been facilitated by Medicaid home and community-based waivers, which allow both homemaker and personal care services to be reimbursed. (Without a waiver, only personal care services can be reimbursed by Medicaid.) Palm Beach County and Chicago, however, use a more traditional model of care, in which personal care is provided by skilled home health agencies and homemaker services are largely provided by volunteers. (Volunteer services are not included in our model) Again, the appropriate solution to this problem is to develop a model which allows users to adapt both the service definitions and the service use rates to meet their needs.

4. Data Issues in Estimating Service Availability

Nonacute care service planning involves making decisions about the allocation of scarce resources and estimating the additional resources required in order to meet service needs, both now and in the future Thus, an essential element in planning is to estimate the services that are currently available and to make projections of future service availability. In terms of our model, this requires planners to make estimates and projections of the availability of the services included in the service configurations.

The difficulties of estimating service availability vary by the type of service; the availability of institutional, residential, and housing services, which are measured in beds or slots, is generally easier to estimate than the availability of home and community-based services, which are typically measured in person-hours. In the field tests, we found that estimating service availability did not appear to pose major problems in New Mexico and Palm Beach County, where the health care delivery systems are relatively small, and nearly all the providers who serve PWAs are known. Estimating service availability is a much more complex problem in a major metropolitan environment, such as Chicago, where many agencies and institutions, scattered all over the city, are providing services to PWAs. To obtain estimates of service availability would require a major effort in Chicago, although this could be of considerable value for the policy planning process.

For staff in both Palm Beach County and Chicago, and, to a lesser extent, in New Mexico, estimating service availability was critically dependent upon source of reimbursement and separating these two concepts was difficult. For example, skilled nursing care was not a constrained *resource* for those with a source of payment, but was severely constrained for the uninsured. This was one of the major reasons why field test participants believed that service populations should be defined by source of payment In the model, the possibility of the existence of different service availabilities for different service populations is taken into account by allowing the user to designate some services as service-population-specific. In the service population structure that we have used, designating some services as service-population-specific was intended to address the issue of some providers being unwilling or unable to serve chemically

dependent adults.[9] However, this approach could also be used to distinguish between the different resources available to PWAs with different payment sources.

D. SERVICE SUBSTITUTION MATRICES

The service populations, patient characteristic groups, and service configurations, described in the previous sections, arc the three essential components of the service substitution matrices, which are the basis of the service planning model. In this section, we first review the structure of the service substitution matrices, and then discuss our field test experiences in using the model as a policy planning tool.

1. Structure of the Service Substitution Matrices

The service substitution matrix for each service population arrays the patient characteristic groups against the corresponding service con&rations, and indicates the range of appropriate service configurations for each group. Appropriate service configurations are defined by the prevailing standards of care in the community. Although one (or more) service configuration(s) may be preferred for each patient characteristic group, several service configurations may be viewed as appropriate alternatives, especially if resources are constrained. For example, AIDS/HIV policy-makers may prefer to serve all severely impaired PWAs in the home if at all possible. However, for severely impaired PWAs who lack caregivers; institutional options-such as skilled nursing homes or hospitals-might be considered appropriate alternatives, particularly if a shortage exists of home- and community-based services.

[9] Unfortunately, this approach only partially addresses the issue of the difference in service availability for chemically-dependent adults. Allowing services to be service-population-specific is an "all-or-nothing" approach, which oversimplifies the existing asymmetry in service availability. Some providers are unwilling to serve chemicallydepcndcnt adults, but many who serve chemically-dependent adults arc quite willing to serve other PWAs also.

Table II.5 shows the service substitution matrix for the chemicallydependent adult serv population. For simplicity, the service configuration titles have been abbreviated Consequen not all the services included in each configuration are listed. In addition, this matrix is actua considerably smaller than the matrix that is included in the microcomputer software modeli system, since all the locational variations in the home- and community-based servi configurations, which distinguish between home and outpatient settings for certain services, a not shown This is, again, to simplify the table.

As can be seen, the majority of the cells in the matrix are empty, representir inappropriate service options. Only the checked cells indicate service configurations that th expert panel and MPR considered appropriate for the corresponding patient characteristic grou These are the default values that are included in the model, but users can modify the matrice to conform to local standards of care. Because of the simplifications made to the table, th number of appropriate service configurations for any patient characteristic groups appears to b small. In fact, much more extensive service substitution can occur in the model, because of thr range of substitution options between in-home and outpatient services.

2 Service Substitution Matrices as Policy Planning Tools

The service substitution matrices were considered to be important policy-making tools in all three field test sites. State and local staff repeatedly stated that the model, and the service substitution matrices on which it is based, provided them with a conceptual framework for reviewing AIDS/HIV service planning issues in an entirely new way. Disagreements with the default service configurations for different patient characteristic groups arose quite frequently during the site visits, but the process of defining appropriate care explicitly was apparently novel, challenging, and helpful.

TABLE 1[1]

SERVICE SUBSTI ATRIX
CHEMICALLY-DEPE. DULTS

	Service Configurations								
	Institutions					Residential Services[3] with:			
	Hospital[1]	Rehabilitative Skilled Care[1]	Extensive Skilled Csre[1]	Hospice Care	Extensive Attendent Care	Moderate Atteadant Care/Standard Nursing Infusions[2]	Moderate Attendant Care/Standard Nursing Ib Infusions	Minimal Attendant Care/Standard Nursing Infusions[2]	Minimal Attendant Care/Standard Nursing No Infusions
Needs aggressive skilled care	X	X							
Needs skilled care constantly ● vrIlr)lr or very **frequently**	X	X	X						
NO PRIVATE HOME AVAILABLE									
Needs and Desires Hospice Care; Live-in Caregiver	X		X	X					
Needs ● ed **Desires Hospice Care; No Live-in Caregiver**	X		X	X					
Severe Impairment; FT Live-in Caregiver; Infusions	X		X						
Severe Impairment; FT Live-in Caregiver; No Infusions	X		X		X				
Severe Impairment; No FT Live-in Caregiver; Infusions	X		X						
Severe Impairment; Ib FT Live-in Caregiver; Ib Infusions	X		X		X				
Moderate Impairment; FT Live-in Caregiver; Infusions			X			X			
Moderate Impairment; FT Llw-In **Caregiver; No Infusions**					X		X		
Moderate Impairment; PT Ltw-In **Caregiver; Infusions**			X			X			
Moderate Impairment; PT Llw-In **Caregiver; No Infusions**					X		X		
Moderate Impairment; No Live-in Caregiver; Infusions			X			X			
Moderate Impairment; No Live-in Caregiver; No Infusions					X		X		
Mild Impairment; Live-in Caregiver; Infusions								X	
Mild Impairment; Live-in Caregiver; No Infusions									X
Mild Impairment; No Llw-In **Caregiver; Infusions**								X	
Mild Impairment; No Live-in Caregiver; Ib **Infusions**									X
No Impairment; Infusions									
No Impairment; No Infusions									
PRIVATE HOME AVAILABLE									
Weeds **and Desires Hospice Care; Live-in Caregiver**	X		X	X					
Needs ● ed **Desires Hospice Care; No Live-in Caregiver**	X		X	X					
Seven **Impairment; FT** Llw-In **Caregiver; Infusions**	X		X						
Severe **Impairment; FT** Llw-In **Caregiver; No Infusions**	X		X		X				
Sewn **Impairment; No FT Live-in Caregiver; Infusions**	X		X						
Severe **Impairment; No FT** Llw-In **Caregiver;** Ib **Infusions**	X		X		X				
Moderate Impairment; FT Llw-In **Caregiver; Infusions**			X			X			
Moderate Impairment; FT Live-in Caregiver; No Infusions					X		X		
Moderate Impairment; PT Live-in Caregiver; Infusions			X			X			
Moderate Impairment; PT Live-in Caregiver; No Infusions					X		X		
Moderate Impairment; No Live-in Caregiver; Infusions			X			X			
Moderate Impairment; No Live-in Caregiver; No Infusions					X		X		
Mild Impairment; Live-in Caregiver; Infusions								X	
Mild Impairment; Live-in Caregiver; Ib **Infusions**									X
Mild Impairment; No Live-in Caregiver; Infusions								X	
Mild Impairment; Ib **Live-in Caregiver; No Infusions**									X
No Impairment; Infusions									
No Impairment; no **Infusions**									

[1]Infusion therapy Is provided in institutions if required.
[2]Infusion therapy con be provided on an outpatient basis or where the patient resides.
[3]Residential facilities ● re a service option for PWAs with live-in caregivers; we em assuming that the caregiver lives outside of the facility and does not provide my care when the patient is placed la a residential facility.

TABLE 11.5 (CONTINUED)

SERVICE SUBSTITUTION MATRIX
CHEMICALLY-DEPENDENT ADULTS

	Housing or Private Home with:[4,5]								
	Substantial Moderate Attendant Care/Standard Hospice	Substantial Attendant Care/Standard Infusions[6]	Moderate Attendant Care/Standard No Infusions	Moderate Attendant Care/Standard Nursing Infusions[6]	Minimal Attendant Care/Standard No Infusions	Minimal Attendant Care/Standard Infusions[6]	Adult Day Care/Standard No Infusions	Adult Day Care/Standard Nursing Infusions[6]	Day Care/Standard Nursing No Infusions
Needs aggressive skilled care									
Needs skilled care constantly available or frequently									
NO PRIVATE HOME AVAILABLE									
Needs and Desires Hospice Care; Live-in Caregiver	X								
Needs and Desires Hospice Car.; Ib Live-in Caregiver									
Severe Impairment; FT Ilw-la Caregiver; Infusions		X							
Severe Impairment; FT Ilw-la Caregiver; Ib Infusions			X						
Severe Impairment; Ib FT Live-in Caregiver; Infusions									
Severe Impairment; Ib FT Live-in Caregiver; Ib Infusions									
Moderate Impairment; FT Live-in Caregiver; Infusions						X			
Moderate Impairment; FT Ilw-la Caregiver; No Infusions							X		
Moderate Impairment; PT Ilw-la Caregiver; Infusions						X		X	
Moderate Impairment; PT Live-in Caregiver; Ib Infusions							X		X
Moderate Impairment; Ib Live-in Caregiver; Infusions				X					
Moderate Impairment; No Ilw-la Caregiver; Ib Infusions					X				
Mild Impairment; Live-in Caregiver; Infusions									
Mild Impairment; Live-in Caregiver; Ib Infusions									
Mild Impairment; Ib Live-in Caregiver; Infusions						X			
Illld Impairment; Ib Live-in Caregiver; No Infusions							X		
No Impairment; Infusions									
No Impairment; No Infusions									
PRIVATE HOME AVAILABLE									
Needs and Desires Hospice Care; Live-in Caregiver	X								
Needs and Desires Hospice Care; No Live-in Caregiver									
Severe Impairment; FT Ilw-la Caregiver; Infusions		X							
Severe Impairment; FT Live-in Careglwr; No Infusions			X						
Severe Impairment; No FT Live-in Caregiver; Infusions									
Severe Impairment; No FT Ilw-la Caregiver; No Infusions									
Moderato Impairment; FT Ilw-la Caregiver; Infusions						X			
Moderate Impairment; FT Live-in Caregiver; No Infusions							X		
Moderate Impairment; PT Live-in Careglwr: Infusions						X		X	
Moderato Impairment; PT Live-in Caregiver; Ib Infusions							X		X
Moderate Impairment; No Ilw-In Caregiver; Infusions				X					
Moderate Impairment; No Ilw-In Caregiver; No Infusions					X				
Mild Impairment; Live-in Caregiver; Infusions									
Mild Impairment; Live-in Caregiver; Ib Infusions									
Mild Impairment; No Live-in Caregiver; Infusions						X			
Illld Impairment; Ib Live-in Caregiver; Ib Infusions							X		
Ib Impairment; Infusions									
Ib Impairment; No Infusions									

[4]For PHAs lacking a private home, these service configurations include housing. Service configurations for PHAs with private bon exclude housing.
[5]Additional housing and private home service configuration can be found on the next page.
[6]Infusion therapy is provided where the patient resides.

TABLE 11.5 (CONTINUED)

SERVICE SUBSTITUTION MATRIX
CHEMICALLY-DEPENDENT ADULTS

	Housing with:				Private Home with:		
	Standard Nursing/ Infusions	Standard Nursing only	Infusions only	Housing Only	Standard Nursing/ Infusions	Standard Nursing Only	Infusions Only
Needs aggressive skilled care							
Needs skilled care constantly **available** or wry **frequently**							
NO PRIVATE HOME AVAILABLE							
Needs an4 **Desires Hospice** Can: **Live-in Caregiver**							
Needs and Desires Hospice Care; No Live-in Caregiver							
Severe Impairment; FT Live-in Caregiver; Infusions							
Severe Impairment; FT Live-in Caregiver; No Infusions							
Severe Impairment; No FT Live-in Caregiver; Infusions							
Severe Impairment; No FT Live-in Caregiver; No Infusions							
Moderate Impairment; FT Live-in Caregiver; Infusions							
Moderate Impairment; FT llw-In **Caregiver; No Infusions**							
Moderate Impairment; PT Live-in Caregiver; Infusions							
Moderate Impairment; PT Live-in Caregiver; lo **Infusions**							
Moderate Impairment; Ib **Live-in Caregiver; Infusions**							
Moderate Impairment; No Live-in Caregiver; II0 **Infusions**							
Mild Impairment; Live-in Caregiver; Infusions	X						
Mild Impairment; Live-in Caregiver; No Infusions		X					
Mild Impairment; No Live-in Caregiver; Infusions							
Mild Impairment; No Live-in Caregiver; No Infusions							
No Impairment; Infusions			X				
No Impairment; No Infusions				X			
PRIVATE HOME AVAILABLE							
Needs and Desires Hospice Care; Live-in Caregiver							
Needs and Desires Hospice Care; No Live-in Caregiver							
Severe Impairment; IT llvv-la **Caregiver; Infusions**							
Severe Impairment; FT Live-in Caregiver; No Infusions							
Severe Impairment; No FT Live-in Caregiver; Infusions							
Severe Impairment; No FT Live-in Caregiver; No Infusions							
Moderate Impairment; FT Live-in Caregiver; Infusions							
Moderate Impairment; FT Live-in Caregiver; lo **Infusions**							
Moderate Impairment; PT Live-in Caregiver; Infusions							
Moderate Impairment; PT Live-in Caregiver; Iio **Infusions**							
Moderate Impairment; Ib **Live-in Caregiver; Infusions**							
Moderate Impairment; No Live-in Caregiver; No Infusions							
Mild Impairment; Live-in Caregiver; Infusions					X		
Mild Impairment; Live-in Caregiver; Ib **Infusions**						X	
Mild Impairment; No Live-in Caregiver; Infusions							
Mild Impairment; No Live-in Caregiver; lb **Infusions**							
No Impairment; Infusions							X
No Impairment; Ib **Infusions**							

For the case managers and service providers who participated in the site visits, a major mental adjustment was required to switch from developing plans of care for individuals to service planning to meet the needs of the entire AIDS/HIV population. The service substitution matrices provided them with a structure to do this, and generated considerable discussion about the actual standards of care in the community and how these compared to the expert panel's recommendations. Based upon our experiences in the site visits, we believe that one of the moat valuable features of the model will be the policy-making process that will be required in order to use it and the debates about appropriate care that it will engender.

III. AIDS/HIV NONACUTE CARE RESOURCE ALLOCATION AND PROJECTION

A major purpose of this project is the development of a software modeling system for planning AIDS/HIV nonacute care services. The conceptual structure presented in Chapter II is one component of this development process, Two other important issues in the development of the software modeling system include:

- Determining which *modeling* frameworks would be useful for the planning of AIDS/HIV nonacute care
- Integrating the conceptual structure into the modeling frameworks

Although several modeling frameworks could be adopted for planning AIDS/HIV nonacute care, MPR has developed two basic approaches that are particularly useful for this purpose. The primary approach, nonacute care resource allocation, uses mathematical optimization techniques to allocate constrained nonacute care resources to PWAs in accordance with particular objectives of the planner. The secondary approach, nonacute care resource need projection, forecasts the resources required to deliver a certain standard of care to the PWA population. The conceptual structure described in the previous chapter has been integrated into these mathematical modeling frameworks to produce and AIDS/HIV nonacute care services projection and optimization model. This model has been incorporated into a user-friendly software modeling system

This chapter discusses the modeling frameworks developed by MPR. Section A discusses the rationale for the development of the two basic modeling approaches. Section B briefly describes the two modeling approach= The corresponding options included in the software modeling system are reviewed in Section C The optimization methodologies underlying the resource allocation approach is presented in Section D. Section E reviews the particular

assumptions on which this resource allocation approach is based and discusses some of the limitations of the software model as a planning tool. Conclusions are presented in section F.

A RATIONALE FOR THE BASIC MODELING APPROACHES

HRSA's Request for Proposal (RFP) for the Study of Methodologies for Determining Nonacute Care Needs for Persons with AIDS/HIV Infection included two requirements that were particularly important in influencing the direction taken by MPR in the development of the basic modeling approaches. Specifically, the RFP stated that the software model resulting from this project should:

- Focus on nonacute care needs; costs should not be explicitly included in the model.
- Allow nonacute care services to substitute for one another where appropriate.

In order to meet the first requirement, MPR considered the development of a service needs projection model While such an approach might be helpful to planners who are focusing on medium- or long-range resource needs, it would not incorporate service substitution possibilities. In addition, a service needs estimation model would not directly confront what MPR staff felt was the most critical issue facing state and local AIDS/HIV service planners, namely resource constraints.

As discussed in Chapter I, many of the communities affected by the AIDS epidemic are experiencing serious burdens on their health care delivery systems. Some states and localities are financially unable to provide adequate care to their PWA populations, as their health care budgets have not been able to meet the needs of their growing AIDS/HIV caseload-a caseload that is increasingly concentrated among the poor, the uninsured, and the underinsured However, low levels of public funding for the provision of HIV nonacute care services is only part of the

reason why nonacute care service resources are in scarce supply; in many communities, sufficient nonacute care resources are just not available to PWAs. Provider unwillingness to care for PWAs, burnout among volunteers and health care personnel, and underdevelopment of local nonacute care service systems-or the part of such systems used by PWAs–are key problems limiting the capacity of local service delivery systems to meet the nonacute care needs of PWAs.

Given the importance placed on resource constraints as a planning factor, MPR adopted a resource allocation approach for modeling AIDS/HIV nonacute care services. As requested by HRSA, the approach was needs-based, in that the methodology was oriented towards evaluating the potential of a nonacute care service delivery system to meet the needs of the PWA population appropriately. Linkages were specified between the patient characteristic groups, service configurations, and services in a manner that allowed services to substitute for each other. Costs were excluded from the model, although our experience on the site visits suggests that a model that considers the cost implications of alternative service delivery goals might be a desired enhancement to the model that we have developed.*'

Although service planners use formal approaches to (1) identify the least restrictive environments for PWAs, (2) assess service needs at both clinical and community levels, and (3) examine utilization patterns among PWAs, to our knowledge there is no analytic framework to help them decide how available resources ought to be allocated. Consequently, resource allocation decisions are often made on piecemeal basis, making it difficult for planners to recognize or confront the implicit priorities and assumptions governing who is being served and how they are being served. A major benefit of an AIDS/HIV nonacute care resource allocation model is that it requires planners to be explicit about their nonacute care service delivery goals and their conceptions of how care ought to be provided

[11]The final chapter of this report discusses this issue in detail.

The development of a software modeling system based on the resource allocation approach results in a highly useful planning tool. However, the utility of the modeling system can extended by including a component that enables users to forecast a community's AIDS/HIV nonacute care resource requirements. Not only are the results generated by this approach useful for assessing future resource needs, but they also provide a valuable standard for comparing analyses performed using the resource allocation approach.

B. BASIC MODELING APPROACHES

The primary modeling framework adopted by MPR is optimization-based resource allocation. This approach enables planners to serve PWAs in a manner that is consistent with their service planning goals, the availability of nonacute care service resources, and their assumptions regarding appropriate standards of care. A customized mathematical programming problem is generated that represents the critical nonacute care relationships existing within the planner's jurisdiction. Essentially, the mathematical programming problem asks the following questions:

- How closely can the user's service planning objectives be achieved given (1) the limited availability of each nonacute care service, (2) the amount of each nonacute care service required by each of service configuration, (3) the range of service configurations that can appropriately meet the needs of each patient characteristic group, and (4) the number of individuals in each patient characteristic group?
- Who gets served and how are they served when the user's objectives have been achieved as closely as possible?
- What resources are required to meet the user's objectives as closely as possible?

A set of equations included in the mathematical programming problem specifies the relationship between each service, service configuration, and patient characteristic group included in the model in order to represent the nonacute care service delivery system of a particular

community. The software modeling system creates and solves the mathematical programming problem, and presents the user with a set of results designed to answer the above questions.

In addition to the resource allocation routines, the modeling system includes a projection methodology, which calculates the amount of each service needed to provide a particular pattern of care. For each patient characteristic group, users indicate one service configuration for serving all of that group's members. The modeling system calculates the service resources needed for the PWA population by multiplying the number of PWAs in each group by that configuration's daily per person service usage rates for each service Service substitution relationships and service availability estimates have no direct role in this approach, although they undoubtedly have a role in the evaluation of the results.[12]

C. MODELING OPTIONS

The resource allocation and resource need projection approaches provide the analytical frameworks for the modeling options included in the software modeling system. These options allow users to:

- Determine unconstrained service needs.
- Maximize the number of people served.
- Serve PWAs based on patient characteristic group priorities.

The first option is based on the service needs projection approach, while the second two are based on the resource allocation approach

"Readers interested in our suggestions on how the options could be used should refer to the User's Guide to the AIDS/HIV Nonacute Care Service Needs Modeling System, which is included as Appendix C

1. Unconstrained Service Needs Estimation

This option allows the user to calculate the service requirements associated with a particular "placement pattern", or pattern of care provision. The user designates a service configuration for each patient characteristic group. The modeling system then calculates the resources required to serve all PWAs in the designated configurations. The designated service configurations might correspond to users' "ideal" placements for each group (e.g., the least restrictive environment), or to some alternative set of placements. The modeling system presents the amount of each service used for each group, and the total service amounts used for all groups.

2. Maximization of the Number of People Served

This option suggests an allocation of resources that is consistent with the goal of serving the maximum possible number of PWAs, given that resources are constrained. Results generated by this option include:

- the number of PWAs from each patient characteristic group that are served
- the; total number of PWAs served
- the amount of each service used
- the number of PWAs served in each service configuration
- the number of PWAs from each patient characteristic group that are served in each configuration

Much can be learned from using this option, but the goal which drives the resulting solution may not be one with which some planners would feel comfortable, as this option (1) serves PWAs based on how much they require of key constrained services, and (2) places these PWAs in the service configurations that require the least amount of these services. In effect, this option

specifies implicit priorities for serving those PWAs requiring the least amount of these services, and for serving them in the least constrained-resource-intensive setting.

3. Serving Based on Patient Characteristic Group Priorities

This option allows users to serve PWAs according to a user-specified priority ranking assigned to each patient characteristic group. The model attempts to serve members of all first-priority-level groups before serving members of any lower- (e.g., second- or third-) priority-level groups. While no more than six priority levels can be specified, users can base the priority ranking on several criteria. The set of results generated for this option is the same as the set generated for the option that maximizes the number of people served.

D. THE OPTIMIZATION MODEL FORMULATION

Underlying the resource allocation approach is a mathematical optimization model that represents our notion of the HIV nonacute care service delivery problem. In this section, we provide an overview of the mathematical model on which the two resource &cation routines are based First, an overview of the optimization approach is presented. This is followed by a brief discussion of the modeling "formulation"-the mathematical representation of the HIV nonacute care delivery problem.

1. Overview of the Approach

The optimization model developed by MPR is based on a technique called linear goal programming. Linear goal programming is a special form of linear programming, an approach for solving problems of a system having objectives and constraints that can be represented by linear equations. The objective is represented by an 'objective function" equation which specifies a quantity to be maximized (or minimized), such as profit (or cost). In linear goal programming the objective function specifies a goal of the system to be achieved as closely as possible. In

addition, a set of constraints-"goal constraints"-must be delineated to facilitate the mathematical representation of the goal in the objective function.

The algorithm used by the software to solve the goal programming model is called the simplex method, which is the most commonly used algorithm for solving linear programming-based problems.[13] Users should be aware that more than one optimal solution usually exists to an optimization model formulations of any size. Consequently, because the simplex method is an iterative procedure, it is possible that no two solutions generated by the modeling software with the same input data will be identical, although the value of the objective function will be the same. In most instances, however, the differences between such solutions will be relative minor.

2. The Modeling Formulation

The modeling formulation is a mathematical representation of the conceptual structure presented in Chapter II, consisting of parameters and equations. In this section, we provide a brief description of the formulation and its inputs.

Parameters are the input data relevant to a particular community, which reflect the "state" of the nonacute care delivery system. The parameters include (1) the number of PWAs in each patient characteristic group, which is indicative of the current need for nonacute care services, (2) the number of units of each service available, which is indicative of the' present capacity of the nonacute care system, and (3) service usage rates, which are indicative of the standards of care in the community.

Three general types of equations are employed in the formulation:

1. Service availability constraint equations

[13]Readers interested in becoming acquainted with the simplex method, linear programming, or goal programming should refer to an introductory operations research textbook, such as Hillier and Lieberman (1986) or Winston (1987).

2 Goal constraint quations
3. Objective function equations

The service availability and goal constraint quations together represent the critical nonacute care linkage, while the goal constraint quations and the objective function equations together delineate the relationship between the objectives of the planner and the nonacute care system. In the following discussion, we first describe the relationship between the service availability and goal constraint equations and the conceptual framework presented in Chapter IL We then review how the modeling formulation represents the user's planning goals.

a Service Availability Constraint Equations

The service availability constraint equations have two major roles in the model:

1. To ensure that the amount of each service used to meet the needs of the PWA population is less than or equal to the amount of that service available

2 To delineate the relationship between the services and service configurations

For example, if hospice nursing care could only be provided in two ways, ie. by two service configurations, the formulation would require that the total amount of hospice nursing assigned through these two configurations would be less than or qual the total amount of hospice care available.

b.. Goal Constraint Equations

The goal constraint quations also have two major roles in the model formulation:

1. To ensure that the number of PWAs that are served from a group is less than or qual to the number total number of PWAs in that group

2 To delineate the relationship between the patient characteristic groups and the service con&rations

Assume for example, that chemically-dependent PWAs who are moderately impaired and have a part-time caregiver could be served by three service configurations. This patient characteristic group's goal constraint quation would ensure that the model did not attempt to serve more of the PWAs than exist in the group. In addition, this equation would specify the linkage between the number of PWAs in the group and the number of these PWAs that are served in each of the three appropriate service configurations.

c. Representation of the Planning Goals

The linear goal programming approach requires that users goals be explicitly defined and related to the rest of the modeling formulation_ The goal constraint equations and the objective function equation are designed for this purpose.

The two resource allocation options in the software allow users to (1) maximize the number of PWA served or (2) serve PWAs based on patient characteristic group priorities. While these options are distinct, the formulations underlying them are similar. The options differ primarily in how the formulations are implemented and the objective functions within these formulations are specified

Maximizing the number of PWAs who are served. The goal of this approach is to allocate scarce HIV nonacute care service resources in a manner that serves the most PWAs possible.

One way to understand the role of the modeling formulation in addressing this goal is to think of it as the regulator of a "competition among PWAs for resources. PWAs (or more realistically, their case managers) bid' for placements in any service configuration that will appropriate meet that individual's need. Because the formulation does not consider any preferences among the appropriate service configurations, these "bids' are for an arbitrarily chosen appropriate service configuration placement However, since the service configurations are really no more than a combination of different nonacute care service resources, these bids

are actually for amounts of different services. If there are enough units of each service to accept all bids, the software reaches a solution in which all PWAs are served. Otherwise, the formulation requires the model to make some choices on a competitive basis Some bids are accepted and others are rejected, based on how effectively the critically constrained resources are conserved. However, when a bid is rejected, the formulation requires the PWA to submit another bid for a slot in a different appropriate configuration. If this new bid saves more of the key resources than the bids accepted earlier, the model accepts it and rejects the most inefficient of the previously accepted bids. Otherwise, this new bid is rejected. This process continues until all of the losers" have had the opportunity to bid for a slot in all of their appropriate configurations.

Serving PWAs based on group priorities. The application of this option requires planners to specify a priority ranking for each patient characteristic group that reflects their service planning goals. The software modeling system then generates and solves a multistage modeling formulation.

This process begins with the creation of a customized mathematical model which attempts to maximize the number of "first-priority PWAs" that are served. Once this model is solved, another, nearly identical mathematical model is generated which attempts to maximize the number of "second-priority PWAs" that are served while simultaneously ensuring that the maximum number of individuals from the first priority level groups are served. Successive mathematical models are generated and solved until the number of specified priority levels have been exhausted. The solution that results from this multistage modeling process will be consistent with the priority ranking specified by the user.

The characterization used for the other resource allocation option applies here, although in an extended form The first-stage model conducts the "competition" described above, but only among members of the first priority level groups. Once the bidding process is over, the software

modeling system records the number of PWAs who are served and prepares the second-round model.

The bidding process is conducted again, and members of the first and second priority level groups participate - but the rules are slightly different Despite the resource savings that could result, the formulation mandates that the number of toppriority PWAs served in this round be equal to the number that were served in the first round; however, there are no requirements concerning who among them will be served or how they will be served. Consequently, the formulation, while mandating the number of top priority bids, accepts those top priority bids that allow the maximum number of second priority PWAs to be served. This same prioritized-bidding process continues in each round until the final-round bidding process is completed The allocation of resources that result will be consistent with the priorities designated by the users.

E. ASSUMPTIONS AND LIMITATIONS

The usefulness of the two resource allocation options developed by MPR depend to a great extent on the accuracy of their underlying modeling formulations. These formulations embody many assumptions employed by our conceptual approach. Most of these assumptions have been discussed elsewhere in this report or in Bilheimer, Phillips, and Asher (1990).

In this section, we review (1) those assumptions that have important implications for the resource allocation options included in the software modeling system, and (2) some of the limitations of the modeling system as a planning tool.

1. Assumptions

The methodological approach that we have used is based on key assumptions related to one or more of the components of the conceptual structure of the model-patient characteristic groups, services, service con&rations, and service usage rates-or their linkages. These assumptions include the following:

- The members of a patient characteristic groups must be homogeneous in their nonacute care needs. An important issue is the extent to which the characteristics that determine nonacute care needs are included in MPR's patient characteristic group definitions. If key characteristics have been omitted, the groups will not be homogenous in their nonacute care needs. In this case, service configurations that are designated as appropriate for a particular group may only be appropriate for some group members. As a result, the placement and resource allocation patterns generated by the software modeling system not only will be inconsistent with the optimal achievement of the user's goal, but they may also be incompatible with appropriate standards of care.

- **Available service units must be homogeneous in their ability to provide nonacute care.** Just as all PWAs within a patient characteristic group are assumed to have the same nonacute care needs, service categories must be defined precisely enough so that all units of a service are considered to be identical. Each unit of a service is considered to be equally productive and equally accessible to all PWAs requiring that service.[14]

- All services that affect where some PWAs are placed, or whether they are placed, must be included in the model. The comprehensiveness of the services included in the model is an important issue. Many services were excluded from our list, and we expect that planners would also exclude most of these services. We believe that these services, while an important part of the care received by PWAs, are not critical in determining how-or whether-a PWA receives care. However, if there are services omitted from the model which are critical in this respect and limited in availability, the solutions generated by the software may have little relation to either an advisable planning approach or to the service delivery capacity of the community under examination.

[14] An important exception is service-population-speci6c services. Users can designate any service to be provided separately to each service population. Separately service availability estimates are provided for each service population, and separate service availability equations are specified for each service population.

- **All of the major ways in which nonacute care is provided are represented by a service configuration included in the** model. Realistic service substitution linkages cannot be represented unless all of the important "bundles" of services that provide a day of care to PWAs are Specified

- **The service availability estimates must correspond to the PWA population under examination. The** patient characteristic group members must be **defined** as some population of **PWAs** needing **nonacute** care, and the units of each service available must be **defined** as those **service** units available to this wnulation of PWAs. Because many of **the** services included in the software are also used by **other** ill persons, specifying estimates of the number of service units available **exclusively** to **PWAs,** or a selected population of **PWAs,** would be extremely difficult for users. Nonetheless, we believe **that this** is **necessary.**

- **Each parameter included in the model formulation is known with certainty. The goal** programming model treats the patient characteristic groups, **the** service availability estimates, and the service usage rate estimates as fixed constants, the value of which is known with certainty. While this assumption is clearly false, user can evaluate how sensitive **model** solutions are to changes in the parameters.

2 Limitations

Although the modeling system provides a valuable framework for service planning, there are some **limitations** associated with it. These limitations include:

- **The narrow range of modeling options available. The software allows users** to (1) project the service needs associated with a particular standard of care, (2) determine an allocation of resources that is consistent with the goal of **maximizing** the number of **PWAs** that are served, and (3) determine an allocation of resources that is consistent with serving **PWAs** based on a group priorities. While some planning criteria can be represented by one of these three options, we expect that users may be most interested in options that allow them to **specify** other priorities. For instance, **a** planner might be interested in serving **PWAs** based on a ranking of each group's appropriate **service configurations,** or serving **PWAs** based on **both** service configuration and group priority **rankings.**

- **The lack of a role for service costs. The** inclusion of a cost component in the model was beyond the scope of this project However, we believe that the inclusion of **service** costs inclusion could substantially broaden the role of the modeling system as a policy planning tool by allowing

users to answer a greater variety of key planning questions. This is discussed in greater detail in Chapter VL

- **The trade-off between the richness and the parsimony of the approach.** The conceptual structure on which the approach is based defines both patient characteristic groups and service configurations in a very detailed manner. As a result, the key nonacute care relationships can be represented. Unfortunately, this structure, which is essential for modeling service substitution, makes the model somewhat complex, and places heavy data demands on users.

D. CONCLUSIONS

The software model developed MPR integrates the conceptual framework and the three modeling options into a promising tool for AIDS/HIV nonacute care service planning. These options (1) forecast nonacute care needs, (2) maximize the number of PWAs that can be served, and (3) serve PWAs based on a priority ranking they assign to each group. These options allow uses to examine their AIDS/HIV nonacute care delivery systems from a number of angles by answering questions such as:

- Who gets served, and how are they served, when a particular goal is specified?
- How should resources be allocated to meet this goal?
- What are the implications of changes in (a) the number of PWAs requiring care, or (b) the resources available to meet nonacute care service needs?

Currently, optimization-based approaches are not widely used to plan nonacute care services for PWAs or other chronically ill populations. However, we believe that these types of models arc potentially powerful tools for addressing important health policy questions.

IV. THE MICROCOMPUTER MODEL FOR PLANNING AIDS/HIV NONACUTE CARE SERVICES

The previous chapters review our conceptual approach to planning the allocation of AIDS/HIV nonacute care resources and introduce the concepts of service populations, patient characteristic groups, service configurations, service substitutions, and optimization. In this chapter, we describe the microcomputer-based tool that we have developed to assist policy-makers and planners in applying these concepts to real-world situations. First, the structure of the software modeling system is discussed. This is followed by a review of the software implementation. The chapter concludes with a discussion of potential modifications to the modeling software, suggested by field test participants to facilitate use of the modeling system

A. STRUCTURE OF THE SOFIWARE MODELING SYSTEM

The conceptual approach, described in earlier chapters, suggests that the software modeling system should allow the user to:

- Specify the service populations, patient characteristic groups, services, and service configurations.
- Provide (1) prevalence estimates for each service population/patient characteristic group, and (2) estimates of the amount of each service available.
- Define combinations of services as service configurations.
- Specify appropriate service configurations for different patient characteristic groups in the service substitution matrices.
- Establish priorities for serving PWAs in different service configurations.
- Gauge the impact of alternative service delivery goals under resource constraints, through the implementation of an optimization algorithm_

The structure of MPR's software system mirrors these requirements, with the following modules that address each basic requirement:

- **Parameter Labels. This module allows the user** to **modify** the lists of services and service configurations that are **included** in the model as defaults. The modeling system has two **service** populations, which can be labeled by the user, but the number of service populations cannot be increased- In addition, the patient characteristic groups included in the model are fixed. These two restrictions result from the conceptual structure of the **model.**

- **Prevalence/Service Availability. This** module **allows** the user to provide service population/patient characteristic group prevalence estimates and estimates of the amount of each service that is available.

- **Service Configurations. This** module allows the users to define service configurations and to designate appropriate service **configurations** in the service substitution matrix.

- Priority **Designation. This** module **allows** the user to designate the "ideal" service **configuration** for each service population/patient characteristic group. The module may also be used to assign a service priority ranking to each service **population/patient** characteristic group.

- Resource **Allocation. This** module allows the user to specify service planning **objectives.** Options include (1) serving **PWAs** in each patient characteristic group in their "ideal" **configuration** assuming no resource constraints, (2) serving **PWAs** in a manner which **maximizes** the number of people served, given the resource constraints, and (3) serving **PWAs** according to priorities placed upon different patient characteristic groups, given resource constraints.

- Allocation **Results. This** module allows the user to review the results of the allocation. The ability to print the results **and/or** store the results in a computer file is also provided

- **Maintenance. This** module allows the user to save model settings or retrieve previous or default settings. This promotes the use of the model for sensitivity analyses and guards against data loss resulting from computer hardware failures.

B. SOFIWAREIMPLEMENTATION

In selecting the software package to be used for the modeling system, **MPR first** identified a set of performance requirements and selection constraints. Software packages which satisfied these requirements and constraints were evaluated and ranked, and a software package was then selected. The evaluation andselection process is reviewed in this section In addition, an issue

raised during the evaluation concerned requirements that users should be able to customize to model in order to satisfy their own needs. This issue is also addressed in detail below.

1. Performance Requirements and Selection Constraints

The software selected for the system needed to satisfy the following basic criteria:

a. The software must meet the processing and computational requirements of the system.

Since the target population for the system is the novice computer user, the system needs to employ a menu-oriented user interface. The system is required to perform several numeric calculations on arrays in order to produce estimates of service needs. Therefore, the software selected must simultaneously support the development of menus and allow for number-intensive processing. Software packages such as Lotus provide a "user-friendly" interface but are cumbersome and slow in processing arrays. Procedural languages such as FORTRAN are efficient at processing arrays of numeric data but are less flexible with screen I/O processing. The dBase dialects such as Fox Base and Clipper are procedural languages with relatively efficient array processing and screen I/O capabilities.

b. The system must be resistent to accidental changes or modifications which would result in estimation errors or unsuccessful oneration of the model.

Models based on spreadsheets or interpreted languages may be easily modified by non-programmers. A model consisting only of executable cede is more secure. Modifications of these systems require more sophisticated programming expertise

c. The software must operate on the intended hardware with the desired operating system.

After consulting with HRSA and several states, MPR determined that the system should operate on an IBM PC/XT/AT or clone microcomputer running PC DOS or MS DOS. This

hardware/operating system platform is the most common on the state level and offers the largest base of packaged software products and tools from which to select MPR feels that the system should be able to operate on a standard PC/XT containing a hard disk and 640K of memory. Software requiring the use of more sophisticated or faster processors and expanded or extended memory will place unnecessary restrictions on the use of the software system This configuration is identical to that required for the PRODAS system used by the states to collect AIDS data for the Centers for Disease Control.

d. Users need to be able to customize the system to their individual needs.

MPR felt that the ability to customize a system such as the service needs model is more a function of the system design than the software selected for the model's development. The implemented model design provides for substantial customizing while maintaining the overall integrity of the system A detailed discussion of this issue is presented below.

e. The use of the modeling system should not require the purchase of additional software or hardware.

Spreadsheet-based modeling system would require each user to obtain a copy of Lotus or a similar package. Other packages require payments of royalties. Other software packages would generate an executable, "stand-alone" modeling system which would not require the purchase of additional software or payments of royalties.

f. The system must satisfy any HRSA-specific software standards.

Detailed software development standards apparently do not exist at HRSA Current microcomputer-based applications utilize popular software packages such as Lotus, dBASE, Fox Base, and Clipper. HRSA does not appear to have substantially more experience in using a particular package or language.

g. The system should utilize readily-available software with a large user base.

Such products typically enjoy superior vendor support. This is particularly important during the development stages. In addition, by virtue of their popularity, more programmers are likely to be familiar with the package, thus simplifying maintenance and future enhancements.

After analyzing these requirements, MPR concluded that the desired software for developing the model should:

- Operate on an IBM PC/XT/AT under MS DOS (hard disk, 640K).
- Produce executable code which could be distributed freely without requiring additional software or royalty payments.
- Provide for efficient screen I/O and numeric processing.
- Be readily available and commonly used.

2 Selected Software

The software packages satisfying the above criteria are Fox Base and Clipper. The products are direct competitors and have similar features. Prices are also similar. The most significant difference is that Clipper supports an unlimited number of fields per record Clipper also produces standalone executable files while Fox Base requires the use of a relatively large run-time module. The Fox Base run-time module also has a somewhat restrictive licensing agreement. Based on these factors, MPR selected Clipper as the software package to be used for the user interface.

Rather than designing and implementing an optimization algorithm from scratch, MPR obtained and modified Stanford University's MINOS program. MINOS is a large-scale optimization system for the solution of linear and non-linear programs. Development of MINOS was sponsored by the U.S. Department of Energy, the National Science Foundation, the U.S.

Army Research Office, and the Office of Naval Research. MPR converted portions of the MINOS system to operate on an microcomputer.

3. User Modifications

An issue of particular importance to HRSA was the need to allow users to modify the software easily. The structure of the implemented system largely satisfies this requirement. The system consists of parameter labels, parameter values, designation assumptions, algorithms and reports. Some of the parameter labels can be modified by the user, but the patient characteristic groups are currently fixed. The parameter values and the designation assumptions are all provided by the user, although MPR has provided initial default assumptions on appropriate service configurations in the service substitution matrices.

The parameters and assumptions are manipulated by a series of algorithms, and a set of service need estimates are generated A set of standard reports are produced from the estimates generated by the algorithms. The manner in which the assumptions, parameters, and algorithms are tied together is determined by the structure of the system Users can alter the parameters and assumptions, but they may not alter the structure of the system or modify the algorithms. To alter the structure of the system would require the use of purchased software and programming expertise. Thus, for example, users will be able to vary the prevalence estimates by patient characteristic group, the service availability estimates, and the designation of appropriate service configurations, but they will not be able to modify the algorithm used to allocate resources subject to service availability constraints.

4. Proposed Modifications to the Current Software

When we field-tested the modeling system, participants all commented on the user-friendliness of the software, but pointed out several modifications that would facilitate model use. Some of the issues that arose during the first site visit in New Mexico were addressed

immediately, and the modifications were in place for the Palm Beach County and Chicago site visits. Other proposed suggestions include the following

- **Totals in summary** tables. In the field test version of the model, the majority of the summary tables did not include totals. The addition of totals in both input and output summary tables would greatly assist users. This change has been implemented in the final version of the modeling system.

- **Input data tables. Users** would like to be able to obtain print-outs of the input data tables, in order to have the most recent version available as they review the results.

- **Flowchart of submodules. The modeling** system has numerous modules and submodules. Including a more detailed flowchart of all the submodules in the documentation would be helpful.

- **Example in user manual.** A detailed case study, that walks the user through all the steps in using the modeling system, would he helpful.

- **Inclusion of decimal amounts in service availability estimates.** Currently, the service availability estimates keyed in by the user can only include whole numbers. At one of the site visits, decimal amounts were needed.

In addition to these changes designed to enhance user-friendliness, site visit participants wanted more flexibility to adapt the number of service populations and patient characteristic groups to meet their needs. Chicago, for example, would like to use three service populations rather than two, and to reduce the number of patient characteristic groups. Not only would this require significant programming modifications, but also extensive user documentation would be necessary in order for users to understand how they were changing the conceptual structure of the model and the implications of this.

V. USING THE MODEL AS A POLICY TOOL: A CASE STUDY

Previous chapters describe the conceptual structure of the AIDS/HIV nonacute care services modeling system, the projection and resource allocation modeling frameworks, and the microcomputer-based software model, which operationalizes these concepts. In this chapter, the use of the modeling system as a policy tool is demonstrated through the use of a hypothetical case study. The modeling system in its entirety is large and complex, and produces extensive detailed output In this case study, however, we will focus on only a portion of the system's output, in order to highlight some important features of the model for policy-makers and planners.

The first step in the case study is to describe the service population/patient characteristic group prevalence estimates. These prevalence estimates are then used in four different scenarios: (1) estimating the resources needs to serve all PWAs in their ideal service configurations; (2) maximizing the number of people served, when resources are tightly constrained; (3) maximizing the number of people served, when some resources are less tightly constrained; and (4) serving based on a priority ranking of patient characteristic groups, with the same level of resources as in the previous scenario. We will examine who gets served and who does not get served under these different scenarios, and the variations in the services that are used.

A. PREVALENCE ESTIMATES

In this hypothetical example, we assume that we are planning AIDS/HIV nonacute care services in an urban community with 450-500 living PWAs.[15] For planning purposes, two adult PWA service populations are used: chemicallydependent adults, who constitute approximately

[15] A point estimate of 476 living PWAs is assumed for the planning period under consideration.

20 percent of the adult PWA population, and other adults. In addition, we assume that patient characteristic group estimates can be made for each service population.

Table V.l shows the service population/patient characteristic group prevalence estimates to be used in the case study. An important point to note is that these prevalence estimates include only a fraction of the patient characteristic groups in the model. This, we believe, reflects reality; in many communities some of the patient characteristic groups will be null sets. In addition, we have assumed that a significantly lower percentage of chemically-dependent adults have private homes available than other adults_

B. SERVING PWAS IN IDEAL SERVICE CONFIGURATIONS

To estimate the resources required to serve all PWAs in their ideal service configurations, users must first specify the ideal configuration for each service population/patient characteristic group. This is illustrated in Table V.2, which shows the service configurations that we selected. Our "ideal" choices had a strong home- and community-based service orientation. In addition, we assumed that, among persons being served in home- and community-based settings, those who were moderately or severely impaired would receive standard nursing and infusion therapy at home, while mildly impaired people would receive these services in an outpatient setting.

The amounts of each service needed per day to serve PWAs in these selected service configurations are shown in Table V3. All service providers are assumed to serve both service populations, except for attendant care which is assumed to be a service-population-specific service. These aggregate service amounts reflect the level of each service that is assumed in each of the service configurations, which are the default values included in the model. (For details of these default values, see Appendices B and C). When we field-tested the model, participants in all three sites were generally surprised by the magnitude of the service amounts shown in this table. The large amounts of attendant care, home infusion therapy, and transportation needed

TABLE V.l

PREVALENCE ESTIMATES BY SERVICE
POPULATION/PATENT CHARACTERISTIC GROUP

Service Population/Patient Characteristic Group	Estimated Prevalence
I. CHEMICALLY-DEPENDENT ADULTS	
No Private Home Available	
Severely Impaired; No Full-time Live-In Caregiver; Infusions	40
Moderately Impaired; No Live-in Caregiver; Infusions	18
Moderately Impaired; No Live-in Caregiver; No Infusions	6
Mildly Impaired; Live-in Caregiver; Infusions	3
Mildly Impaired; Live-in Caregiver; No Infusions	7
Mildly Impair&, No Live-in Caregiver; Infusions	3
Mildly Impaired; No Live-in Caregiver; No Infusions	7
Private Home Available	
Moderately Impaired; Full-time Live-in Caregiver; Infusions	12
TOTAL CHEMICALLY-DEPENDENT ADULTS	96
I. OTHER ADULTS	
Needs Aggressive Skilled Care	10
Needs Skilled Care Frequently	10
No Private Home Available	
Severely Impaired; Full-time Live-in Caregiver; Infusions	20
Private Home Available	
Severely Impaired; Full-time Live-In, Caregiver Infusions	20
Moderately Impaired; Full-time Live-in Caregiver; Infusions	60
Moderately Impaired, No Live-in Caregiver; Infusions	90
Moderately Impaired; No Live-in Caregiver; No Infusions	30
Mildly Impaired; Live-in Caregiver; Infusions	16
Mildly Impaired; Live-in Caregiver; No Infusions	40
Mildly Impair& No Live-in Caregiver; Infusions	24
Mildly Impaired; No Live-in Caregiver; No Infusions	60
TOTAL OTHER ADULTS	380
TOTAL PREVALENCE	476

Service Population/ Characteristic Group	Service Configuration
L CHEMICALLY DEPENDENT ADULTS	
No Private Home Available	
Severely **Impaired;** No Full-the **Live-in** Caregiver; **Infusions**	Rehabilitative Skilled Care Facility
Moderately Impaired; No **Live-in Caregiver;** Infusions	Moderate Attendant **Care** Facility; Home Standard Nursing; Home **Infusions;** Drug **Treatment**
Moderately Impaired; No **Live-in Caregiver;** No **Infusions**	Moderate Attendant Care **Facility;** Home Standard **Nursing;** Drug **Treatment**
Mildly Impaired; **Live-in Caregiver; Infusions**	Housing; Transportation; Case Management; Outpatient Standard Nursing; Outpatient infusions
Mildly Impaired; Live-in Caregiver; No **Infusions**	Housing; **Transportation; Case** Management; **Outpatient Standard Nursing;** Drug **Treatment**
Mildly Impaired; No Live-in Caregiver; Infusions	Housing; Minimal Attendant Care; **Transportation;** Case Management; Outpatient Standard Nursing; Outpatient **Infusions;** Drug **Treatment**
Mildly Impaired; No **Live-in Caregiver;** No **Infusions**	Housing; Minimal Attendant Care; **Transportation;** Case Management; Outpatient Standard Nursing; Drug **Treatment**
Private Home Available	
Moderately Impaired; Full-time **Live-in Caregiver;** Infusions	**Minimal** Attendant Care; **Transportation; Case** Management; Home Standard Nursing; Home Infusions; Drug **Treatment**
IL oTl-II3zADuLl-s	
Needs Aggressive Skilled **Care**	Rehabilitative **Skilled Care** Fadlity
Needs **Skilled** Care **Frequently**	**Extensive** Skilled **Care** Facility

TABLE V.2 (continued)

Service Population/ Characteristic Group	Service Configuration
No Private Home Available	
Severely Impaired; Full-time Live-in Caregiver; Infusions	Extensive Skilled Care Facility
Private Home Available	
Severely Impaired; Full-time Live-in Caregiver; Infusions	Substantial Attendant Care; Transportation; Case Management; Home Standard Nursing; Home Infusions
Moderately Impaired; Full-time Live-in Caregiver; Infusions	Minimal Attendant Care; Transportation; Case Management; Home Standard Nursing; Home Infusions
Moderately Impaired; No Live-in Caregiver; Infusions	Moderate Attendant Care; Transportation; Case Management; Home Standard Nursing; Home Infusions
Moderately Impaired; No Live-in Caregiver; No Infusions	Moderate Attendant Care; Transportation; Case Management; Home Standard Nursing;
Mildly Impaired; Live-in Caregiver; Infusions	Transportation; Case Management; Outpatient Standard Nursing; Outpatient Infusions
Mildly Impaired; Live-in Caregiver; No Infusions	Transportation; Case Management; Outpatient Standard Nursing
Mildly Impaired; No Live-in Caregiver; Infusions	Minimal Attendant Care; Transportation; Case Management; Outpatient Standard Nursing; Outpatient Infusions
Mildly Impaired; No Live-in Caregiver; No Infusions	Minimal Attendant Care; Transportation; Case Management; Outpatient Standard Nursing

TABLE V3

RESOURCES NEEDED TO SERVE ALL PWAS IN IDEAL CON-FIGURATIONS

SERVICE	UNIT OF SERVICE	AMOUNT PER DAY
Rehabilitative Skilled Care Facility	Beds	50
Extensive Skilled Care Facility	Beds	30
Moderate Attendant Care Residence	Beds	24
Housing	Slots	36
Home Infusion Therapy	Slots	200
Outpatient Infusion Therapy	Slots	46
Home Standard Nursing	Hours	74
Outpatient Standard Nursing	Hours	52
Attendant Care		
Chemicallydependent Adults	Hours	31
Other Adults	Hours	597
Case Management	Hours	24
Drug Treatment	Slots	30
Transportation	Round Trips	105

are particularly startling to AIDS/HIV service planners. Note, however, that home infusion services are based upon one treatment per day, with no self-administration (or administration by an informal caregiver). Transportation needs, too, are assumed to be met entirely by an outside source.

C. MAXIMIZING THE NUMBER OF PEOPLE SERVED (I)

In this scenario, we consider the implications of tight restrictions on the supplies of most of the services needed to serve PWAs. Given scarce resources, we wish to maximize the number of people served, with no priorities for serving particular patient characteristic groups first. The appropriate service configurations for each patient characteristic group correspond to those shown in the service substitution matrix in Table IL!!.

Service availability assumptions are shown in Table V.4. As can be seen, most services are assumed to be quite tightly constrained, when compared to the amounts needed to serve PWAs in ideal configurations. Residential care facilities are not available at all, and the hospital is now used as an appropriate service alternative for some PWAs. No service availability amounts are shown for case management or drug treatment, since the availability of these two services is not assumed to affect placement' Rather, the model estimates the total amounts needed of these services, given the placements that result from the other constrained resources.

In addition to the service amounts available, Table V.4 shows the amount of each service that is actually used, under the maximizing the number of people served scenario. At first these results seem surprising, since, even though very limited amounts are available, some services are not used In particular, none of the outpatient standard nursing and infusion nursing services are used at all. These results reflect the fact that other services are so tightly constrained, that the use of service configurations that employ outpatient services is not feasible. A clue to the

TABLE V.4

RESOURCES USED TO MAXIMIZE THE NUMBER OF PEOPLE SERVED, WITH CON- RESOURCES (I)

SERVICE	UNIT OF SERVICE	AMOUNT OF SERVICE AVAILABLE PER DAY	AMOUNT OF SERVICE USED
Hospital	Beds	30	30
Rehabilitative Skilled Care Facility	Beds	10	10
Extensive Skilled Care Facility	Beds	20	20
Housing	Slots	20	20
Home Infusion Therapy	Slots	40	40
Outpatient Infusion Therapy	Slots	40	0
Home Standard Nursing	Hours	40	31
Outpatient Standard Nursing	Hours	40	0
Attendant Care			
Chemicallydependent Adults	Hours	30	30
Other Adults	Hours	60	60
Case Management	Hours	•	8
Drug Treatment	Slots	•	16
Transportation	Round Trips	10	10

*The amounts of these two services are not entered into the model as service availability constraints. Rather, the model estimates the amounts of these two services needed to support the resulting placement pattern.

problem lies in the relatively small amounts of transportation services and attendant care for other adults that are available.

The actual numbers of people in each service population/patient characteristic group who are served under this scenario can be seen in Table V.5. One-third of the total PWA population is served, with an approximately proportional distribution between chemicallydependent adults and other adults. When we examine the distribution by patient characteristic group, however, we find that the placement pattern is biased towards the two ends of the severity spectrum. In this scenario, since we are maximizing the number of people served, the home and community-based services that are available will be used by those with the lowest levels of need first, because the greatest number of people can be served this way. Since these services are tightly constrained, no severely impaired people are served in home- and community-based service configurations. At the other end of the severity spectrum, institutional services are only designated as appropriate service options for all severely impaired PWAs and for some moderately impaired PWAs. (Extensive skilled care facilities are assumed to be appropriate placements for moderately impaired PWAs needing infusion therapy.) Consequently, the institutional placements are used by the more severely impaired characteristic groups. However, because institutional placements are tightly constrained, a significant percentage of severely impaired people are not served. (This is compounded by the fact that some moderately impaired people are also competing for these placements.)

D. MAXIMIZING THE NUMBER OF PEOPLE SERVED (II)

In this scenario, the amounts of some of the more tightly constrained resources-housing, attendant care for non-chemicallydependent adults, and transportation-are increased. This is illustrated in Table V.6, which also shows the amounts of each service used when the number of

TABLE V.5

PERSONS SERVED WHEN MAXIMIZING THE
NUMBER OF PEOPLE SERVED, WITH CONSTRAINED RESOURCES (I)

Service Population/Patient Characteristic Group	Number Served	Number Unserved
L CHEMICALLY-DEPENDENT ADULTS		
No Private Home Available		
Severely Impaired; No Full-time Live-In Caregiver; Infusions	0	40
Moderately Impaired; No Live-in Caregiver; Infusions	0	18
Moderately Impaired; No Live-in Caregiver; No Infusions	4	2
Mildly Impaired; Live-in Caregiver; infusions	3	0
Mildly Impaired; Live-in Caregiver; No Infusions	7	0
Mildly Impaired; No Live-in Caregiver; Infusions	2	1
Mildly Impaired; No Live-in Caregiver; No Infusions	2	5
Private Home Available		
Moderately Impaired; Full-time Live-in Caregiver; Infusions	12	0
TOTAL CHEMICALLY-DEPENDENT ADULTS	30	66
IL OTHERADULTS		
Needs Aggressive Skilled Care	0	10
Needs Skilled Care Frequently	10	0
No Private Home Available		
Severely Impaired; Full-time Live-in Caregiver; Infusions	16	4
Private Home Available		
Severely Impaired; Full-time Live-In; Caregiver Infusions	20	0
Moderately Impaired; Full-time Live-in Caregiver; Infusions	0	60
Moderately Impaired; No Live-in Caregiver; Infusions	20	70
Moderately Impaired; No Live-in Caregiver; No Infusions	0	30
Mildly Impaired; Live-in Caregiver; Infusions	16	0
Mildly Impaired; Live-in Caregiver; No Infusions	40	0
Mildly Impaired; No Live-in Caregiver; Infusions	0	24
Mildly Impaired; No Live-in Caregiver; No Infusions	8	52
TOTAL OTHER ADULTS	130	250
TOTAL	160	316

TABLE V.6

RESOURCES USED TO MAXIMIZE NUMBER OF PEOPLE SERVED WITH CON STRAINED RESOURCES (II)

Service	unit Of service	Amount Of Service Available Per Day	Increase in Amount of Service Available from Maximizing Number Served (I)	Amount Of Service used Per Day	Increase in Amount of Service used horn Maximizing Number Served (I)
Hospital	Beds	30	0	30	0
Rehabilitative Skilled Care Facility	Beds	10	0	10	0
Extensive Skilled Care Facility	Beds	20	0	20	0
Housing	Slots	40	20	22	2
Home Infusion Nursing	Slots	40	0	40	0
Outpatient Infusion Nursing	Slots	40	0	6	6
Home Standard Nursing	Hours	40	0	40	9
Outpatient Standard Nursing	Hours	40	0	7	7
Attendant Care					
Chemically-dependent Adults	Hours	30	0	30	0
Other Adults	Hours	80	20	80	20
Case Management	Slots	*	*	11	3
Drug Treatment	Slots	*	*	17	1
Transportation	Round Trips	30	20	24	14

*The amounts of these two services are not entered into the model as service availability constraints. Rather, the model estimates the amounts of these two services needed to support the resulting placement pattern.

people served is maximized. All of the additional attendant care available is used, as is a significant amount of the additional transportation, but only a small amount of the additional housing is used. In addition, some of the other home- and community-based services, which were unused in the previous scenario, are now used..

The fact that not all of the additional resources are used, illustrates the important point that the critical bottlenecks in serving people change as the relative availability of different services changes. For example, the supply of housing and transportation now appears to be plentiful. What this really means, however, is that additional amounts of these services would not allow any more people to be served, because other critical services are so tightly constrained. Table V.6 suggests that the critical bottleneck in serving people at home or in housing is attendant care. If attendant care availability increased significantly, housing and transportation, or other services, might again become critical bottlenecks. The model output actually provides the user with information to indicate which services are currently causing bottlenecks.[16] We have not included these data in the table, however, because they are difficult to interpret and to use them effectively requires considerable experience with the model.

The changes in the number of people served in different patient characteristic groups, in comparison to the first scenario, are shown in Table V.7. These figures must be interpreted carefully, since not all of the changes in numbers served are related to the expanded service availability. Specifically, the small positive and negative changes in the numbers of severely and moderately impaired people served represent arbitrary shifts in the allocation of institutional placements, since the modeling system has been given no instructions to prefer one equally resource-intensive patient characteristic group to another. Thus, the net change in the number

[16]This numerical information, which is known as the "marginal impact" information is discussed in the User's Guide for the modeling system, included as Appendix C.

TABLE V.7

PERSONS SERVED WHEN MAXIMIZING THE
NUMBER OF PEOPLE SERVED (II)

Service Population/Patient Characteristic Group	Number Served	Number Unserved	change in Number from Maximizing Number Served (I)
CHEMICALLY-DEPENDENT ADULTS			
No Private Home Available			
Severely Impaired; No Full-time Live-In Caregiver; Infusions	0	40	0
Moderately Impaired; No Live-in Caregiver; Infusions	1	17	1
Moderately Impaired; No Live-in Caregiver; No Infusions	0	6	-4
Mildly Impaired; Live-in Caregiver; Infusions	3	0	0
Mildly Impaired; Live-in Caregiver; No Infusions	7	0	0
Mildly Impaired; No Live-in Caregiver; Infusions	3	0	1
Mildly Impaired; No Live-in Caregiver; No Infusions	7	0	S
Private Home Available			
Moderately Impaired, Full-time Live-in Caregiver; Infusions	12	0	0
TOTAL CHEMICALLY-DEPENDENT ADULTS	33	63	3
OTHER ADULTS			
Needs Aggressive Skilled Care	0	10	0
Needs Skilled Care Frequently	10	0	0
No Private Home Available			
Severely impair* Full-time Live-in Caregiver; Infusions	10	10	-6
Private Home Available			
Severely Impaired; Full-time Live-In; Caregiver Infusions	20	0	0
Moderately Impaired; Full-time Live-in Caregiver; Infusions	9	51	9
Moderately Impaired; No Live-in Caregiver; Infusions	20	70	0
Moderately Impaired; No Live-in Caregiver; No infusions	0	30	0
Mildly Impaired; Live-in Caregiver; Infusions	16	0	0
Mildly Impair@ Live-in Caregiver; No Infusions	40	0	
Mildly Impaired; No Live-in Caregiver; Infusions	0	24	8
Mildly impaired, No Live-in Caregiver; No Infusions	57	3	49
TOTAL OTHER ADULTS	182	198	52
TOTAL	215	261	55

people served is maximized. Ail of the additional attendant care available is used, as is a significant amount of the additional transportation, but only a small amount of the additional increases in numbers served are in the mildly impaired service categories, which is to be expected. Using the option to maximize the number of people served, when more home and community-based services become available, the modeling system allocates those resources to gain the maximum increase in the numbers of people served. The net increase in the number of people served, in comparison to the first scenario is 55. This still leaves over half the population unserved, including many of the most severely impaired PWAs.

E. SERVING BASED ON PATIENT CHARACTERISTIC GROUP PRIORITIES

The results from the option which maximizes the number of people served provide a useful baseline for subsequent planning activities. If PWAs at all impairment levels are competing for the same resources, and only limited amounts of these resources are available, then placing priorities on the more severely impaired patient characteristic groups may significantly reduce the number of people who can be served.

In this scenario, we use a priority ranking for serving different patient characteristic groups, with the same amounts of each service available as in the previous scenario. The priority ranking used is as follows:

- First Priority: All severely impaired PWAs (including those in "high-level" groups)
- Second Priority: All other PWAs without private homes
- Third Priority All other PWAs

Having severely impaired PWAs as the first priority, the modeling system attempts to place as many severely impaired PWAs into appropriate service configurations as possible, using the entire spectrum of appropriate institutional and home- and community-based service configurations.

Because the severely impaired have intensive resource needs, serving them first absorbs the bulk of the tightly constrained home- and community-based resources, especially attendant care. Having placed as many severely impaired PWAs as possible, the modeling system then uses the remaining resources to serve as many additional PWAs lacking private homes as possible, before any other PWAs are served.

Table V.8 shows the amounts of each service used under this scenario, and contrasts these with the amounts used under the scenario which maximized the number of people served. Since attendant care is such a bottleneck--especially, given the amounts needed by the severely impaired-the amounts used of the other home and community-based services are reduced because many fewer people can now be served in home- and community-based settings. Housing use increases significantly however, which is a result of the second priority to serve PWAs without private homes.

The numbers of people served using these priorities are shown in Table V.9, which compares these numbers with the numbers served under the previous scenario. As one might expect, a significant change occurs in both the numbers served and their characteristics. Increases occur in the numbers of severely impaired PWAs and PWAs without private homes who are served. This is accompanied by a decline in the number of moderately impaired and mildly impaired PWAs who are served. The net effect is to reduce the total number of people served by28 percent.

F. DISCUSSION

The simple hypothetical ease study used in this chapter illustrates how the software modeling system can be used to explore the policy implications of alternative assumptions about the characteristics of the PWA population and resource availability. As stated previously, the modeling system is quite complex and we have only shown a portion of the output here To

TABLE V.8

RESOURCES USED WHEN SERVING BASED ON PRIORITIES, WITH CONSTRAINED SERVICES

Service	unit of Service	Amount of Service Available Per Day	Amount of Service Used Per Day	Difference in Amount of Service Used From Maximizing Number Served (II)
Hospital	Beds	30	30	0
Rehabilitative Skilled Care Facility	Beds	10	10	0
Extensive Skilled Care Facility	Beds	20	20	0
Housing	Slots	40	39	17
Home Infusion Therapy	Slots	40	32	-8
Outpatient Infusion Therapy	Slots	40	3	-3
Home Standard Nursing	Hours	40	29	-11
Outpatient Standard Nursing	Hours	40	0	-7
Attendant Care				
Chemicallydependent Adults	Hours	30	30	0
Other Adults	Hours	80	80	0
Case Management	Hours	•	7	-4
Drug Treatment	Slots	•	15	-2
Transportation	Round Trips	30	12	-12

*The amounts of these two resources are not entered into the model as service availability constraints. Rather, the model estimates the amounts of these two services needed to support the resulting placement pattern.

TABLE V.9

PERSONS SERVED WHEN SERVING BASED ON PRIORITIES, WITH CONSTRAINED RESOURCES

Service Population/Patient Characteristic Group	Number Served	Number Unserved	Change in Number from Maximizing Number Served (II)
I. CHEMICALLY-DEPENDENT ADULTS			
No Private Home Available			
Severely Impaired; No Full-time Live-In Caregiver; Infusions	10	30	10
Moderately Impaired; No Live-in Caregiver; Infusions	3	15	2
Moderately Impaired; No Live-in Caregiveq No Infusions	6	0	6
Mildly Impaired; Live-in Caregiver; Infusions	3	0	0
Mildly Impaired; Live-in Caregiveq No Infusions	7	0	0
Mildly Impaired, No Live-in Caregiveq Infusions	3	0	0
Mildly Impaired; No Live-in Caregiver; NO Infusions	7	0	0
Private Home Available			
Moderately Impair@ Full-time Live-in Caregiver; Infusions	0	12	-12
TOTAL CHEMICALLY-DEPENDENT ADULTS	39	57	6
OTHER ADULTS			
Needs Aggressive Skilled Care	10	0	10
Needs Skilled Care Frequently	10	0	0
No Private Home Available			
Severely Impaired; Full-time Live-in Caregiver; Infusions	20	0	10
Private Home Available			
Severely Impaired; Full-time Live-In; Caregiver Infusions	20	0	0
Moderately Impaired; Full-time Live-in Caregiveq Infusions	0	60	-9
Moderately Impaired; No Live-in Caregiver; Infusions	0	90	-20
Moderately Impaired; No Live-in Caregiver; No Infusions	0	30	0
Mildly Impaired; Live-in Caregiver; Infusions	16	0	0
Mildly Impaired; Live-in Caregiver; No Infusions	40	0	0
Mildly Impaired; No Live-in Caregiver; Infusions	0	24	0
Mildly Impaired; No Live-in Caregiver; No Infusions	0	60	-57
TOTAL OTHER ADULTS	116	264	-66
TOTAL	155	321	-60

maximize ik effectiveness as a policy and planning tool, the modeling system requires an experienced user with extensive knowledge of the AIDS/HIV service planning issues in the community. This experience and knowledge is necessary in order to be able to understand and interpret the results from different runs of the modeling system using different assumptions.

Several points were raised during the field test concerning potential modifications to the modeling system that would facilitate the interpretation of the results. These suggestions are in addition to the software enhancements suggested in Chapter IV. The following issues are particularly pertinent to output interpretation:

- Terminology on Output Screens. The terminology on some of the output screens could be revised to enhance user understanding of the results.

- Resources Needed to Serve Different Priority Levels. Users would like to have the capability to see the resources required to serve PWAs in each priority level when the priority option is used.

- Service Units. Some confusion arose during the field tests concerning the units in which services are measured. Because this is not a cost model, the service units vary considerably-from slots to hours to round-trips. Although the service units are documented in the report on the service substitution matrices (Bilheimer, Phillips, and Asher, 1990), users wanted more direct reminders about service units to be included on the screen. In addition, a discussion of the service units in the user manual would be helpful. These additions have been made in the final version of the modeling system.

- Marginal Information. In this chapter, we made brief reference to the "marginal" information included in the model output, which indicates to the user which services are the binding constraints. Users had difficulty interpreting this numerical information, which is a by-product of the goal programming formulation that we have used. Very clear guidance on interpreting marginal information needs to be developed An expanded discussion on marginal information is included in the final version of the user manual.

- Partial Service Configurations. As site visit participants developed a greater understanding of the modeling process, a key point of discussion was the use of partial service configurations. The model assumes that if any service component of a *configuration is* unavailable, then PWAs

cannot be served in that configuration.[17] In reality, however, because of the scarcity of resources, PWAs are served, but the service package is less than appropriate. Consequently, the modeling system underestimates the number of people who would actually be served in some fashion and overestimates the amounts of unused services. Careful documentation of this issue is required, so that users understand the model assumptions and can make appropriate adjustments to the service configurations when some resources are tightly constrained.

These modifications and enhancements would undoubtedly help policy-makers to interpret the output from the modeling system and to understand its policy significance. However, we also believe that the importance of users gaining experience in using the modeling system cannot be overemphasized. Comments were made several times on our site visits to the effect that this is not a tool for the casual user, and we agree with that assessment. At first, the optimization process seems like a "black box" to users. However, we have learned from our own experiences that, through frequent use of the modeling system and experimentation with alternative formulations and assumptions, one develops a more intrinsic understanding of the optimization process and the resource allocation results. Thus, the process of learning to use the system facilitates a greater understanding of the planning process.

[17] This is another reason why the expert panel focused only on those services that they thought were essential, i.e. services without which the service configurations could not provide appropriate care.

VI. FUTURE DIRECTIONS FOR AIDS/HIV NONACUTE CARE SERVICE NEEDS MODELING

This report descrii the AIDS/HIV nonacute care services modeling system developed by MPR over the past year. As a consequence of the expert panel's recommendations and our own experiences in developing the model, the resulting product differs significantly from the model that we envisioned when we began the project. Much has been learned by MPR and HRSA staff, during both the model development process and the field tests, that can provide important insights for future nonacute care modeling activities.

In this final chapter of tbe report, future directions for AIDS/HIV nonacute care services modeling are discussed, focusing on four issues: (1) use of the modeling system as a policy planning tool; (2) potential revisions to the conceptual structure of the model; (3) expansion of the optimization options; and (4) incorporation of service costs.

A. USE OF THE MODEL AS A POLICY PLANNING TOOL

Based on our site visit experiences, the modeling system has important potential as a tool to assist states in the AIDS/HIV nonacute care policy development and planning. The most significant feature of the system is not the microcomputer technology that it employs, but the underlying service substitution matrix structure that it uses. HRSA's original conception of the use of a matrix to display nonacute care service substitutions has proved to be a powerful mechanism for stimulating debate about appropriate standards of care in the community. Thus, we believe that the service substitution matrices themselves can serve as catalysts for the establishment of a policy development and planning process. Furthermore, the service substitution matrix structure potentially has equal utility in planning services for other chronically ill populations and the elderly, where many of the same issues arise.

The incorporation of the service substitution matrices into a microcomputer-based projection and optimization modeling system adds another major dimension to the planning process, by enabling planners to explore the consequences of different policy decisions. For example, we received a uniformly startled reaction when field test participants viewed the resource consequences of placing all PWAs in the least restrictive, appropriate environment; they were surprised by the large estimated amounts of home- and community-based service needed to provide appropriate care. In spite of the data limitations that exist at present, we believe that the modeling system can play an important role in this type of reality testing.

B. REVISIONS TO THE CONCEPTUAL STRUCTURE OF THE MODEL

Although all site visit participants commented on the utility of the service substitution matrices for planning and policy development, they also wanted greater flexibility to adapt the matrices, and the model, to their specific community needs. Two issues were of particular importance: (1) the limitations on the number of service populations; and (2) the fixed nature of the patient characteristic groups. Users would like to be able to expand the number of service populations and modify the patient characteristic groups.

1. Service Population Expansions

In its current form, the model includes two adult service populations; chemicallydependent adults and dther adults. As pointed out earlier, field test participants did not believe that these were the most important service populations for policy and planning purposes, and they wanted to be able both to rename the service Populations and to increase their number. In Chicago, for example, participants wanted to use three service populations: privately insured, Medicaid, and uninsured In the final version of the software modeling system, we have added the capability to rename the service populations, but the number of service populations is still fixed. While this capability could also be established without too much technical difficulty, increasing the number

of service populations increases the burden on the user because the size of model expands greatly. Thus, if this modification is made, care must be taken to ensure that users understand both the data input and model output consequences of service population increases.

2 Patient Characteristic Group Modifications

Data issues were a concern in all three sites--especially in Chicago-and the suggestion was made that we should modify the modeling system to allow users to adapt the patient characteristic groups accordingly. The issue also arose in discussions of infusion therapy, because some participants did not believe that infusion therapy needs were necessary characteristics to include in the model. As with service populations, allowing user modifications to the patient characteristic groups raises concerns and issues that are primarily conceptual rather than technical. The patient characteristic group structure that is used in the model focuses on the characteristics that define groups with relatively homogeneous nonacute care needs. This is essential, in order to define appropriate service substitutions. Collapsing the existing groups into larger groups, may create groups whose members no longer have homogeneous needs, and, hence, nullify the concept of the service substitution matrix.

A hypothetical example illustrates this point. Suppose no information on caregiver availability is included in a community's case management database. Planners, therefore, decide to collapse the patient characteristic groups, by dropping the caregiver characteristic. Severely impaired PWAs living in private homes will now be grouped together, regardless of whether they have full-time caregiver or no caregiver. The appropriate service alternatives clearly differ for those with and without caregivers, but there is now no way to incorporate this into the service substitution matrix Thus, if these increased flexibility modifications are ma& to the modeling system, extensive documentation will be necessary in order for users to understand how patient

characteristic group changes affect the conceptual structure of the model, and the implications of this.

C. EXPANSION OF THE OPTIMIZATION OPTIONS

The current version of the software modeling system includes two optimization options: maximizing the number of people served and serving based upon a priority ranking of patient characteristic groups. These options provide the basis for resource allocation decisions, but more complex optimization options could greatly enhance the model's capabilities and its utility to planners. The two further options that we believe should be considered are (1) setting priorities on within-group service configurations, and (2) allowing more complex priority structures to be specified by the user.

1. Setting Priorities on Within-Group Service Configurations

At present, users cannot set priorities on how PWAs within particular patient characteristic groups are sewed in a constrained situation. The only way to specify how PWAs should be served is with the projection option, in which the modeling system estimates the total amount of resources necessary to serve PWAs according to the user-specified pattern Our experience at the site visits indicates that users would like to be able to set priorities on how-ie. within which service configurations--PWAs in different patient characteristic groups are served, given that a range of appropriate options exists.

To develop this option would require a major programming effort, since some significant modifications and expansions of the current program structure would be necessary. In addition, it would not address all the users' concerns, since ranking patient characteristic groups would not be possible when this option is used.

2 Allowing More Complex Priority Structures

The feedback that we received from field test participants indicated that planners and plicy-makers would really like the ability to tailor priority structures to meet their own needs. This would require the incorporation of elements of the previous option, to specify within-group priorities, with the existing option, to set priorities on patient characteristic groups. The result would be an advanced option that would allow users to set priorities on the patient characteristic groups that are served and how they are served.

This option, too, would require a major programming effort It would also require extensive documentation, and more training than is required for the existing options, in order for planners to use it effectively. However, we believe that planners will want to move in this direction as they gain experience in using the existing options.

D. INCORPORATION OF SERVICE COSTS

The other issue that emerged clearly from the site visits was the importance of incorporating service costs into the model. As originally conceived by HRSA staff, the model was to be needs-based and service costs would not he a factor. Hence, the model developed by MPR was based upon this criterion. However, we were repeatedly informed by site visit participants that the model's utility to policy-makers would be greatly enhanced if the cost consequences of different resource allocation decisions could be analyzed This was viewed as essential, if the output from the modeling system was to serve as the basis for policy position papers to be submitted to governors and legislators.

The inclusion of costs in the model could take a variety of different forms, which would rquire different levels of effort to develop, and would have different consequences for the model structure and modeling system output. Three possibilities are reviewed here: (1) cost multipliers; (2) budget models; and (3) cost minimization models.

1. Cost Multipliers

The simplest approach to adding costs to the model would be to incorporate cost multipliers into the existing structure. Users would enter unit service costs for each service into the software modeling system. Following the usual optimization processes based upon service needs, the resulting service amounts would be multiplied by unit service costs, to determine the total costs of different resource allocation results.

Although this is a very basic approach, our discussions with planners suggest that many users would be quite satisfied with this relatively simple addition to the modeling system. Major advantages of such an approach arc (1) it is easy for users to understand and (2) it would not require a major additional programming effort.

2. Budget Models

At a greater level of complexity, costs could be incorporated through modification of the existing model structure to develop a budget model. Under this structure, the planner's priorities would remain the same, but the availability of particular services would be determined by the planner's overall budget and the cost of the individual services.

This approach has great utility for policy-makers who are working with fixed budgets, and it might be the most preferable structure to use in a planning model in which the service populations are defined by source of payment For example, a budget model clearly ties in with Chicago's proposed service population structure of private insurance, Medicaid, and the uninsured. Resources allocation decisions for the Medicaid-eligible population would be based upon a projected Medicaid budget The budget for the uninsured would be based upon the state and local resources available to serve this population. The budget for the privately-insured would be open-ended for those services covered by private insurance. However, for other services, the privately-insured would have to compete with the uninsured for limited state and local funds.

Ultimately, we believe that users may seek this type of budget model option, because it conforms more closely to the fiscal realities with which they are dealing. However, it will require a much greater modeling system development effort than the cost multiplier option.

3. Cost Minimization Models

This third approach to incorporating costs into the model would significantly change its philosophy and intent. The planner's priorities would now be specified in terms of minimizing the costs of service provision, given an appropriate standard of care The adoption of this approach would also require a major modeling system development effort

We have only discussed this option at any length with the Chicago site visit participants. Although they were very concerned about service costs, and believed that incorporation of service costs into the model was essential, they clearly did not want to use a cost minimization approach. However, in many communities, fiscal realities may force policy-makers to adopt such an approach

E. CONCLUSIONS

The AIDS/HIV nonacute care services modeling system represents a first attempt to develop a microcomputer-based service planning tool using a structure that is based upon the dual concepts of service substitution and optimization. Our experience in field-testing the model suggests that this approach has potentially great value in assisting state and local AIDS/HIV service planners to make critical resource allocation decisions. The service substitution matrix, in particular, provides a conceptual framework for thinking about resource allocation decisions that policy-makers and planners find extremely helpful. The extent to which the modeling system will be used, however, will depend upon whether (1) communities can obtain the necessary data to utilize the model and (2) additional modifications can be made to enhance the model's utility to policy-makers.

If the three field test sites are representative of other communities, progress is certainly being made towards developing the types of database capabilities necessary to support this type of planning effort. HRSA's role in assisting communities *to* develop case management database systems can facilitate this process. Specifically, HRSA's case management and database development activities can provide an important linkage between the data requirements of the modeling system and the individual-level data that are routinely collected as part of case management assessments.

The major additions and modifications that would enhance the utility of the modeling system to policy-makers involve (1) allowing planners to specify more complex priorities, and (2) incorporating costs into the model Both of these expansions would require significant additional development work In addition, if costs are incorporated into the model, important decisions must be made about the appropriate way to do this. A cost minimization methodology, for example, would fundamentally change the philosophical approach towards planning services for persons with AIDS/HIV infection that HRSA has promoted in this project.

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